AL/CF-SR-1995-0007

ARMSTRONG LABORATORY

50 YEARS OF HUMAN ENGINEERING

HISTORY AND CUMULATIVE BIBLIOGRAPHY OF THE FITTS HUMAN ENGINEERING DIVISION (U)

Edited by:
Rebecca J. Green
Herschel C. Self
Tanya S. Ellifritt

CREW SYSTEMS DIRECTORATE
HUMAN ENGINEERING DIVISION
WRIGHT-PATTERSON AFB, OHIO 45433-7022

MAY 1995

Approved for public release; distribution is unlimited

AIR FORCE MATERIEL COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433-7022

Library of Congress Cataloging in Publication Data:

Green, Rebecca J. (Rebecca Jane), 1949- .
50 years of human engineering: history and cumulative bibliography of the Fitts Human Engineering Division
edited by Rebecca J. Green, Herschel C. Self, Tanya S. Ellifritt
p. cm.
Includes index.
1. Airplanes--Design and construction--Human factors--Bibliography. 2. Human engineering--Bibliography. 3. Aeronautics--Human factors--Bibliography. 4. Aeronautics, Military--Bibliography. 5. Armstrong Laboratory (US). Fitts Human Engineering Division--Bibliography. I. Self, Herschel C. (Herschel Clayton), 1922- . II. Ellifritt, Tanya S. (Tanya Sabrina), 1958- III. Armstrong Laboratory (US). Fitts Human Engineering Division. IV. Title.

Z5064.D4G74 1995
[TL553.6] 95-10013
016.6208'2--dc20 CIP

Copies of the technical reports listed in this document may be purchased from:

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161

Federal agencies registered with the Defense Technical Information Center should direct requests for copies of the technical reports listed in this document to:

Defense Technical Information Center
Cameron Station
Alexandria, Virginia 22314

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*

2. REPORT DATE
May 1995

3. REPORT TYPE AND DATES COVERED
1945 - 1994

4. TITLE AND SUBTITLE
50 Years of Human Engineering
History and Cumulative Bibliography of the Fitts Human Engineering Division

5. FUNDING NUMBERS

6. AUTHOR(S)
Edited by: Rebecca J. Green
Herschel C. Self
Tanya S. Ellifritt

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Armstrong Laboratory, Crew Systems Directorate
Human Engineering Division
Human Systems Center
Air Force Materiel Command
Wright-Patterson AFB OH 45433-7022

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
AL/CF-SR-1995-0007

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

This report depicts the Human Engineering Division's research and development efforts spanning the past half-century. It is organized around a reference bibliography comprising technical reports, journal publications, conference proceedings, books and book chapters published between August 1945 and December 1994.

14. SUBJECT TERMS

15. NUMBER OF PAGES
288

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited

FOREWORD

Engineers have been aware of the desirability of designing equipment to meet the requirements of the human operator, but in most cases have lacked the scientific data necessary for accomplishing this aim.

— P.M. Fitts

What is now the Fitts Human Engineering Division began with a directive for establishment of the Psychology Branch in the Aero Medical Laboratory at Wright Field in the closing days of World War II (May 1945). The mission of the Psychology Branch, under the leadership of Lt Col Paul M. Fitts, was the scientific study of human capabilities and characteristics that could be applied to the design of equipment, operations, and work environments. This was a significant event, the first organizational commitment to human engineering research and development undertaken within the United States military.

Successful military performance is dependent on the effective integration of human and systems technologies. Human-centered systems promote mission success through superior operability, maintainability, and survivability. The ultimate advantages of technological advances in controls, displays, and information handling, remain inextricably linked to human factors such as the pilot's sensory, perceptual, cognitive, and motor capabilities; strength and anthropometrics; motivation; experience; and skills. The mission of the Fitts Human Engineering Division is to ensure this linkage by anticipating future needs, developing human engineering technologies, and providing human-system integration design criteria to exploit the fullest potential of the Air Force warfighting team, irrespective of gender, mission, or environment.

Dr. Fitts' legacy of scientific excellence and relevance to military needs is embodied in five productive decades of research by the organization he founded. On this occasion — the fiftieth anniversary of the Fitts Human Engineering Division — we are proud to offer this volume which depicts the Division's research and development efforts spanning the past half-century.

JAMES W. BRINKLEY, SES
Director, Crew Systems

PREFACE

The data, models, guidance, technology demonstrations, and evaluations produced under laboratory research and development efforts are typically archived as technical reports, journal articles, or other professional communications. Ultimately, the scientific and technical documentation is the enduring product of research and development. In the normal course of events, however, collections of these technical information products accumulate and all too often languish in libraries, databases, and proprietary archives. Under these conditions, the value of research and development accomplishments and investments may either be diminished or never attained. Given that the value of information can only be realized through its use, it is therefore vital that responsible research and development managers make every effort to reduce the high costs of "rediscovery" of their research products by potential users.

The mission of the Armstrong Laboratory, Fitts Human Engineering Division involves the definition and documentation of capabilities and limitations of operators through scientific study of human behavior, physical characteristics, physiology, strength, performance, and tolerance of physical and mental stresses to aid the design of technologically superior human-systems. In developing this cumulative bibliographic reference, it was our intent to aid and promote the accessibility of relevant Human Engineering Division research information. Additionally, this commemorative volume is a celebration of five decades of human engineering research and development.

This volume is organized around a reference bibliography comprising the cumulative technical reports, journal publications, conference proceedings, books and book chapters documenting the research and development program of the Fitts Human Engineering Division from August 1945 through December 1994. The bibliography is divided into five sections or decades of activity and is organized alphabetically by author within each of these decades. The bibliography is itself generously illustrated with photos, illustrations, data functions, quotes, biographic notes, and period anecdotes which exemplify the people and events which have shaped the history and character of the division. The introduction includes several narrative histories and an optimistic nod towards the Human Engineering Division's future.

We sincerely hope that you enjoy this historic document. If you have further interest in the mission or products of the Fitts Human Engineering Division, please do not hesitate to contact me at:

FITTS HUMAN ENGINEERING DIVISION
Armstrong Laboratory
AL/CFH, Bldg 248
2255 H Street
Wright-Patterson Air Force Base, OH 45433-7022

or E-MAIL — KBOFF@FALCON.AL.WPAFB.AF.MIL

Kenneth R. Boff, PhD
Chief, Human Engineering Division

ACKNOWLEDGMENTS

No task of this magnitude is accomplished without the contributions of a large and diverse group of people. This project is certainly no exception. It is incumbent upon us, the editors of this document, to see that proper credit is given to the many dedicated and talented people whose efforts brought this project to a successful conclusion.

The inspiration for this document originated with the planned celebration of the 50-year anniversary of what is now called the Human Engineering Division. Located under the Crew Systems Directorate of the Armstrong Laboratory, the Human Engineering Division (AL/CFH) traces its roots to 1945 and the establishment of the Psychology Branch, Aero Medical Laboratory. The concept of producing a bibliography of all research published over 50 years by researchers in the Human Engineering Division and its predecessors is a natural one and is attributable to Dr. Kenneth R. Boff, currently Chief of the Human Engineering Division. Evolution of that concept into the broader, historically enhanced bibliography you see printed here can also be traced to Dr. Boff. It is safe to say that Dr. Boff was the creative and driving force behind this project. He gave us lofty goals to meet, high standards to guide us along the way, and the resources needed to succeed. To the extent that this document conveys the sense that Air Force human engineering for half a century has been both productive and fascinating, the credit goes to Dr. Boff.

Getting from decades-old partial bibliographies captured in various forms and formats to a cohesive 50-year bibliography was a triumph of both automation and brute force. Key to the success of this project was the technical and clerical support of employees of our engineering support services contractor, Logicon Technical Services, Inc. Leading the way was Susan Pfaadt, Software Department Manager. Susan waged a successful year-long campaign to develop a flexible database in which to store the 2,500-plus citations that represent the 50-year research throughput of the Human Engineering Division. She converted bibliographic inputs from WORDSTAR and other arcane bibliographic databases, managed the hand entry of citations when necessary, identified spurious data entries, and "ported" the finished data to a desktop publishing computer program. Susan went on to become a full member of the project team, and the editors wish to express their deep appreciation for her countless valuable suggestions regarding all aspects of the project.

Not the least of her contributions was Susan's hiring of a subcontractor to build the electronic copy of the bibliography in PAGEMAKER, a desktop publishing computer program. The young lady, Kimberly Kayler Izenson, proved to be another "hero" of this project. With a work ethic that left us in awe, Kimberly pulled together pieces from dozens of contributors and, in less time than we could imagine, laid out a tasteful, visually appealing, accurate document. It is important to note, also, that Kimberly was a frequent, valuable contributor of ideas for making improvements to this document. She was an emergent leader taking responsibility for facets of this project, such as scanning illustrations into the computer and single-handedly building an author index, for which she was not originally responsible. Her flexibility and enthusiasm were both welcome and fortuitous. Recognition is also due David Spangler of LTSI for a summer-long dedicated effort at keystroking citations into the computer database.

A project of this scope demands leadership to succeed. In each stage of this effort, leadership was passed to the project team member with the necessary skills to see that stage successfully through to completion. Special thanks, however, go to Walt Summers, Chief of the Ergonomics Analysis Branch, for his central role, largely during the late stages of the project, in pulling together parallel activities and focusing them toward completion. He skillfully walked the fine line between realizing the best product possible and getting the project done in a timely fashion. His quiet, understated manner was instrumental in facilitating the process of emergent leadership.

Many other major contributions to the success of the project came from members of the Ergonomics Analysis Branch of the Human Engineering Division. Renee Kaffenbarger, for example, stood as a skilled and willing typist and proofreader. Time and again, she keystroked valuable and historical documents into her word processor for inclusion in the bibliography. While the documents were often long, Renee's responses were always rapid, skillful, and congenial—she is a truly remarkable individual and a treasured resource. Early in this project, SSgt Wiley Wells, also of AL/CFHA, got us started in the graphics portion of the project by digitally scanning all the graphics selected for the book up to that time.

The gifted interviewing techniques of Dr. Reuben Hann were enlisted as part of this project to capture the recollections of key figures in the division's history. Lew's interviews with the likes of Dr. Melvin Warrick, Steve Heckart, Dr. Robert O'Donnell, Dr. Don Topmiller, and Charlie Clauser, add a warm, human touch to this work. Lew also extracted quotes from material gathered earlier in interviews with Earl Sharp and Phil Kulwicki. We thank him and the seven interviewees for their prompt and valuable participation. Dr. Ken Kennedy, whose interview was regrettably lost due to a recording difficulty, also deserves our thanks. In addition, our grateful acknowledgment is extended to Steve Heckart and Jean Ring for their generosity in contributing valuable early technical reports and articles from their personal collections.

Another contributor deserving of special recognition is Wayne Martin. A long-time member of the Human Engineering Division, who moved on to assignments elsewhere in the Crew Systems Directorate, Wayne generously contributed two anecdotes which give the reader valuable insight into life in the Human Engineering Division some decades back. Dean Kocian and Dr. Joe McDaniel of the Human Engineering Division deserve similar praise for their fascinating historical timelines of two key human engineering technologies. Dean's history of helmet-mounted device technology forcefully illustrates the central role played by the division in the development of the entire helmet-mounted sight, helmet-mounted display, night vision goggle, and virtual reality fields. Similarly, Joe McDaniel's history of workplace accommodation traces for the reader the long and rich history of yet another central facet of human engineering technology. Our grateful thanks go out to each of these authors for taking time during a particularly hectic time of year to provide these valued documents.

Help from outside the Human Engineering Division family should also be recognized. Mike Gallagher of the Defense Printing Service Detachment Office was particularly patient, participating in long meetings and taking numerous phone inquiries, all in the name of educating us in the complexities of printing a document of this nature. That he succeeded, in large measure, is credit to his skill and determination. Thanks are also extended to Klein Associates for sharing with us the results of interviews conducted with Earl Sharp and Phil Kulwicki. Though conducted for another purpose, the interviews provide delightful insights into long-standing and special relationships between the division and some of its "customers."

Valuable support was provided by administrators at several levels. Within the division, Randy Yates, of the Design Technology Branch, was a valuable source of information and help in setting up and using the computer hardware and software facilities required to do this job. Randy's support is particularly noteworthy given that the timing of our requests for support coincided exactly with the busiest time of year for Randy's other support commitments. Patricia M. Lewandowski, the Crew Systems Directorate STINFO (Science and Technology Information Officer), was also a source of crucial support to us in getting clearance of this document for public release, advice on publication procedures, and assistance in recovering bibliographic information from directorate files.

Proofreading, however painful, is pivotal in a project of this type. We had the good fortune on this effort of having some of the best proofreaders around on our team. Besides Kimberly Izenson herself, our proofreading corps included Elizabeth Combs and Anita Cochran. Betsy Combs, the current division secretary, suffered from work overload even without this proofreading assignment. But, that never stopped her before and it didn't this time either. The thoroughness and accuracy of Betsy's proofreading were incredible. One of the few proofreaders in Betsy's league is Anita Cochran. Anita is retired from the University of Dayton Research Institute and was available to us as a consultant through the Crew System Ergonomics Information Analysis Center, or CSERIAC. She performed the final edit on all parts of this document, including all citations, the list of illustrations, and the author index, always patiently waiting on us for material and then responding magnificently to our need for quick turnaround. Her comments and corrections were absolutely essential. She is amazing. An additional note of thanks goes out to countless contributors of ideas, photographs, text, corrections, etc., who cannot, for reasons of practicality, be cited individually here—your generosity is nonetheless noted and appreciated.

This brings us to our final acknowledgment. The editors wish to acknowledge the magnificent skill, knowledge, energy, enthusiasm, and dedication of the men and women of the Human Engineering Division, both past and present. The experience of compiling and editing this book drove home in unmistakable terms the staggering accomplishments of this merry band of human engineers. We have drawn freely from their lore in putting this document together. Exemplary of that group is Dr. Melvin Warrick, former Associate Division Chief of the Human Engineering Division. Mel was with the Human Engineering Division, then the Psychology Branch, in 1946, and he is still with us, as a volunteer, today. An invaluable resource for this project in terms of identifying people, facilities and programs from old-time documents, and verifying the historical accuracy of our entries, Mel represents the embodiment of the collective human engineering spirit—a proud, industrious, intellectual, and obviously well published scientific family.

Table of Contents

List of Illustrations

SECTION 1 - 50 YEARS OF HUMAN ENGINEERING: NARRATIVE HISTORY

I. ORGANIZATION, MISSION, AND GOALS

The Fitts Human Engineering Division is one of three research divisions within the Crew Systems Directorate of the Armstrong Laboratory, headquartered at Brooks Air Force Base, San Antonio, Texas (Figure 1-1). The mission of the Fitts Human Engineering Division is to enable or ensure the effective integration of humans with technology in USAF systems. Research and Development (R&D) is directed at boosting system performance and affordability by enhancing the operability, supportability, and survivability of these complex human systems. The scope of the R&D program encompasses three areas of regard:

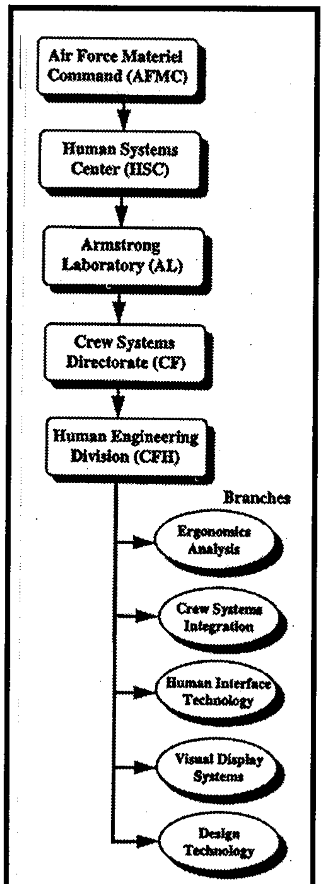


FIGURE 1-1: ORGANIZATIONAL CHART

(1) **Information Management & Display** develops methods and media to ensure reliable access to and decision making with task critical information by individuals, teams, and organizations;

(2) **Performance Aiding** produces innovative technologies for assisting operators and maintainers in performing their jobs more effectively, thereby minimizing human error while optimizing speed and quality of mission performance; and,

(3) **Design Integration** advances specialized databases, metrics, tools, and models of human capabilities and attributes to ensure that equipment designs support the fullest potential of warfighters, irrespective of gender, mission, or environment.

R&D in each of these technical problem areas may be conducted under the core program or as a rapid response to customer requirements. The latter activity, analogous to "fire-fighting," is characterized by short-suspense problem-solving "in the field" using the best data, knowledge, and skills that are readily available (Figure 1-2) . This activity has typically encompassed consulting and trouble-shooting of human factors problems with military equipment during design, integration, test and evaluation, and deployment or operations in varying stages of the acquisition process or in the field. Increasingly, this "fire-fighting" activity includes response to commercial industry, academia, local government, and other federal agencies. Most of these efforts are directly funded or cost-reimbursed by customers and, in recent years, have encompassed approximately 30 percent of the total activity of the division. This work has been especially vital to maintaining the relevance of our overall R&D program to USAF and military needs.

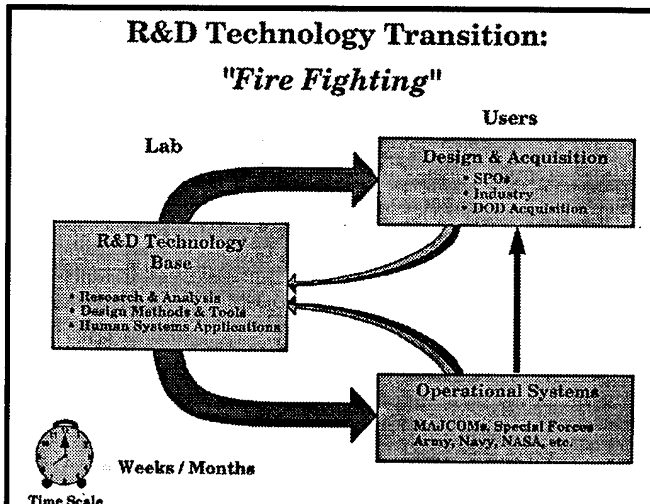


FIGURE 1-2: FIRE FIGHTING

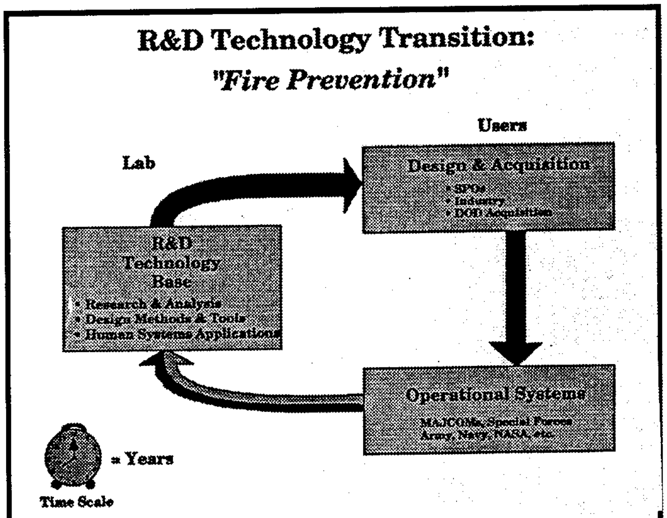


FIGURE 1-3: FIRE PREVENTION

Human Engineering Division Facilities

Design Technology Laboratories
- Behavioral Visualization Laboratory
- Crew-Centered Analysis and Design Support Laboratory (C-CADS)
- Computerized Anthropometric Research and Design Laboratories (CARD)
- Physical Ergonomics Laboratory (PEL)

Crew Systems Integration
- Multi-Operator Design Assessment Laboratory
- Crew Aiding and Information Warfare Analysis Laboratory (CIWAL)

Operator Assessment Technologies
- Cognitive Assessment Laboratory (CAL)
- Flight Psychophysiology Laboratory

Adaptive Interface Technologies
- Synthesized Immersion Research Environment (SIRE)
- Virtual Environment Interface Laboratory (VEIL)
- Fusion Interface for Tactical Environments (FITE)
- Alternative Control Technology (ACT)

Advanced Helmet Display Systems
- Night Vision Operations Laboratory
- Visually Coupled Systems Development and Visual Interface Laboratory
- Visual Image Evaluation of Windscreens Laboratory
- Dynamic Visual Assessment Facility (DVAF)
- Color Display Laboratory (CDL)
- Aerospace Vision Laboratory (AVL)

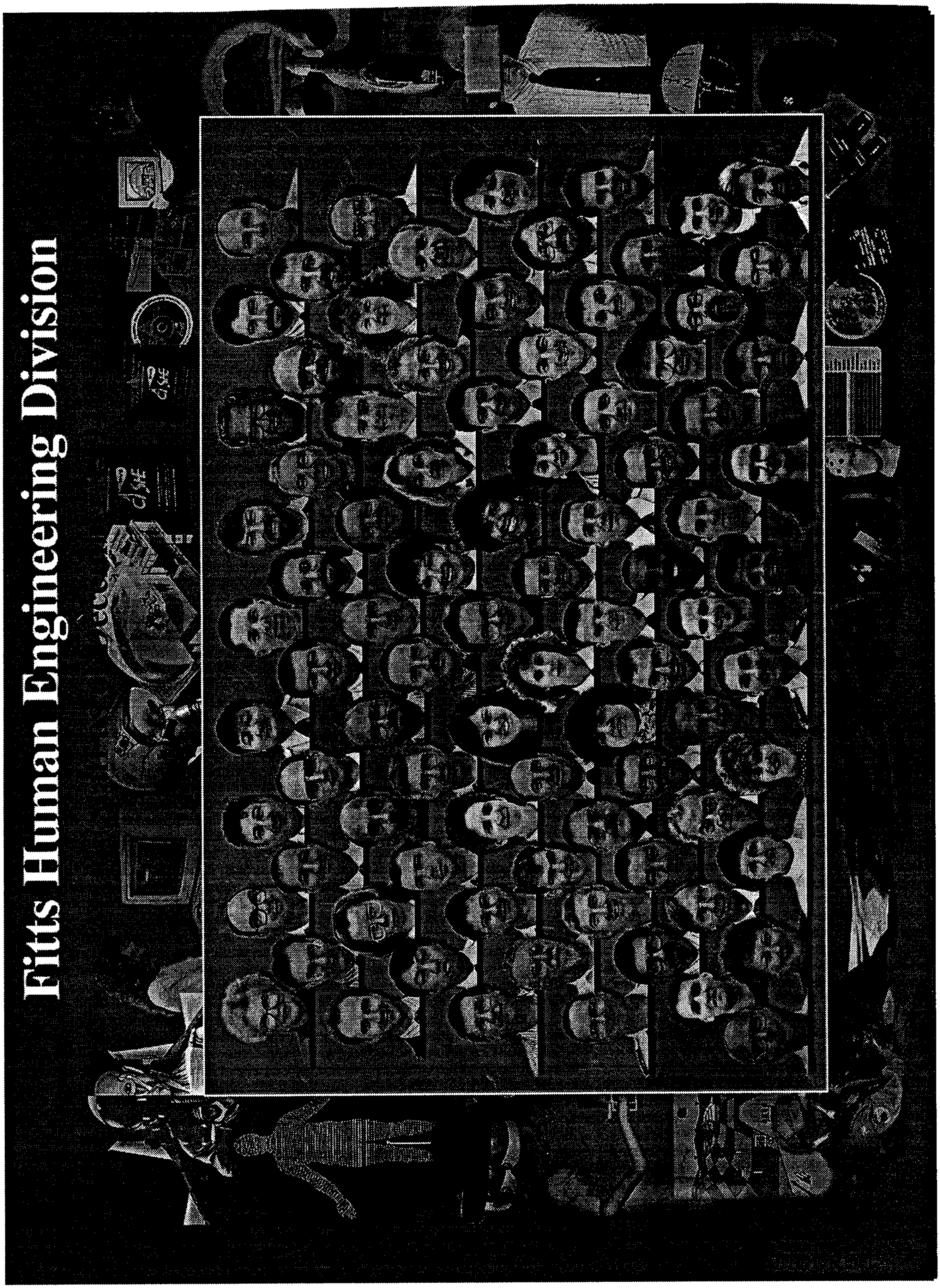
TABLE 1-1: LIST OF HUMAN ENGINEERING DIVISION FACILITIES

The core program, accounting for approximately 70 percent of the activity of the Fitts Human Engineering Division, is focused on building the technology base, tools, techniques, and media to leverage and extend the capabilities of future warfighters in the operation and support of complex systems. Analogous to "fire-prevention," these efforts are concerned with preventing today's problems from recurring in tomorrow's systems by anticipating USAF needs and getting "ahead of requirements." In performing this activity, user needs must often be "pushed" to recognition of emerging human engineering technologies and best practices (Figure 1-3). Our considerable success in this area is demonstrated by a sustained high percentage of customer funding of our science and technology program.

Work is executed through five Branches: Ergonomics Analysis; Design Technology; Human Interface Technology; Crew Systems Integration; and Visual Display Systems. Within the division, there are 18 specialized laboratories and facilities (Table 1-1) distributed over six buildings (Bldgs 248, 248A 33, 196, 197, 29) on Area B of Wright-Patterson AFB. The core strength of the organization is reflected in the quality and breadth of division personnel (Figure 1-4). Our present staff includes 86 civil service, military, and visiting scientists, over 60 percent of whom hold advanced degrees (26 percent MS, 35 percent PhD, two percent

FIGURE 1-4: HUMAN ENGINEERING DIVISION STAFF (AS OF DEC 94)

Top to Bottom and Left to Right (10 Rows)
1. Anne Cato, Albert Chapin, Alan Pinkus, Capt Scott Smith, 1st Lt Bryan Christensen, Alan Straub, William Kama, Robert Osgood, Bradley Purvis
2. Dean Kocian, Christopher Russell, Craig Arndt, Donald Monk, David Post, Herschel Self, Gregory Zehner, John Bridenbaugh
3. Jeffrey Craig, Gloria Calhoun, Gilbert Kuperman, Grant McMillan, Gary Reid, Glenn Wilson, Capt Jeffrey Hoffmeister, Denise Wilson, Brian Tsou
4. Capt John Crist, Capt Stuart Turner, Lt Col James LaSalvia, Joe McDaniel, June Skelly, Jennifer Whitestone, Kathleen Robinette, Reuben Hann
5. Lee Task, Capt Larry Wiley, Maj Julie Cohen, Beverly Gable, Mark Cannon, Marya Beverly, 1st Lt Mike Kasic, Capt Luis Rodriguez, Laura Mulford
6. Earl Sharp, 1st Lt Michael Stratton, Lt Col Michael Eller, 1st Lt Lawrie Hamacher, Michael Haas, Mary-Louise Smith, Sqn Ldr Greg Underhill, Michael Vidulich
7. Lt Col Melvin O'Neal, Lt Col Paul Morton, Randall Brown, Renee Kaffenbarger, 1st Lt Ralph Korthauer, TSgt Raymond Morandi, Maj Edward Fix, Capt Michael Pietryga, Peter Marasco
8. Robert Eggleston, Lt Col Gerald Gleason, Nilss Aume, Nick Longinow, SSgt Otis Newsome, Philip Kulwicki, Michael McNeese, Maj Mark Waltensperger
9. 2d Lt Darryn Bryant, Maris Vikmanis, Melvin Warrick, Walter Summers, 1st Lt Robert MacMillan, Capt Ronald Merryman, MSgt Robert Stewart, Richard Warren, Capt Steve Beyer
10. Robert Centers, Rebecca Green, Theresa Schiavone, Elizabeth Combs, Lt Col William Wittman, Helen Redwine-Smith, Tanya Ellifritt, Ronald Yates, TSgt Wiley Wells, Kenneth Boff


Fitts Human Engineering Division

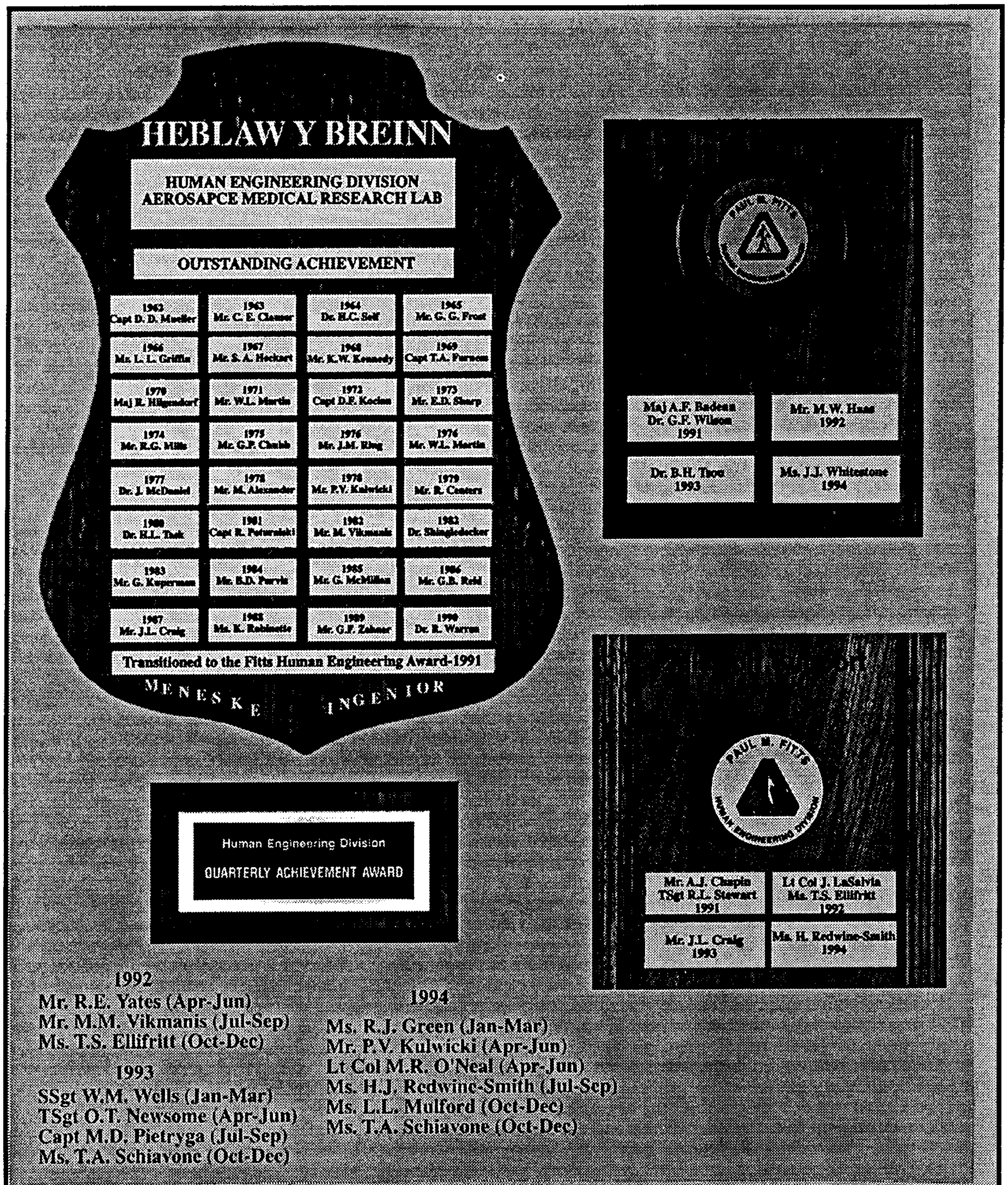


FIGURE 1-5: HUMAN ENGINEERING DIVISION AWARD WINNERS

MD) representing a wide range of scientific and engineering disciplines including psychologists, physiologists, physicists, physicians, mathematicians, computer scientists, and aeronautical, electrical, human factors, industrial, and mechanical engineers. These division researchers are generally recognized nationally and internationally in their respective areas of expertise and have collectively authored numerous scientific publications as journal articles, technical reports, books, and symposia proceedings.

Several awards are conferred to honor the achievements of division personnel. The winners of these awards are noted in Figure 1-5. The Paul M. Fitts Award for Human Engineering Excellence is awarded for significant achievement in human factors basic

science, engineering, or technology transition. It has been awarded annually since 1991, at which time it replaced the division's Human Engineer of the Year Award, first awarded in 1962. The Mission Support Award was also initiated in 1991, and is awarded annually to members of the staff who, in the spirit of total quality management, exceeded their job requirements; displayed initiative, perseverance, and dedication of mission; improved management procedures or methods of service; proved successful in administration, contract management, or coordination of programs; or successfully represented the division with outside organizations. Additionally, a division Quarterly Achievement Award is given to individuals whose accomplishments over the preceding three months have significantly furthered the Human Engineering Division or brought recognition to the division in the science and engineering communities.

Supplementing this government staff is a multi-disciplinary cadre of approximately 170 on-site support professionals representing six independent R&D companies. These are Ball Systems Engineering Division, Logicon Technical Services Inc. (LTSI), Science Applications International Corporation (SAIC), Sytronics, Inc., University of Dayton Research Institute (UDRI), and VEDA Inc. Whereas the division takes pride in its core competency and technology leadership, as demonstrated by the quality of its in-house research programs, these and other contracts with universities and industry extend our capabilities and encourage external participation.

The unique R&D assets within the Fitts Human Engineering Division make it a national center of excellence which leads the nation's human factors research efforts. Our value continues to grow with public recognition that effective human integration with complex technologies in tasks, jobs, and processes from the factory floor to the family living room is the key to affordability and international economic competitiveness. Products from our R&D investments have been extensively and successfully used by industry, academia, local government, and other federal agencies. Multi-use applications have been achieved, or are planned, in medical instrumentation and techniques, automotive interior packaging and assembly, industrial safety and job design, job performance aiding, computer-aided human engineering, and entertainment.

SECTION 1 - 50 YEARS OF HUMAN ENGINEERING: NARRATIVE HISTORY

II. HISTORY

The remainder of this section is divided into two parts: Human Engineering: 1945-1984, and Fitts Human Engineering Division: 1985-Present. This somewhat unusual structure was selected, in part, to reuse a remarkable history of the division's first 40 years, written by Dr. Walt Grether for the occasion of the 50th anniversary of the Air Force Aerospace Medical Research Laboratory. In it, he captures the flow of important events, the goals, and the mood of the organization throughout the 40-year period. Following Dr. Grether's account is a contemporary perspective of the Human Engineering Division focusing on the most recent ten years of its existence. This thorough overview of the division's structure, mission, practices, research programs, accomplishments, and facilities provides a snapshot of the division and its members today and is a sound basis for predicting the future of the organization over the next 50 years.

HUMAN ENGINEERING: THE FIRST 40 YEARS* 1945-1984

by Walter F. Grether, PhD
Chief, Psychology Branch (1949-1956)

Today we are celebrating the 50th anniversary of the founding of the great institution that is now called the Air Force Aerospace Medical Research Laboratory. During the 50 years of its existence, this laboratory has contributed immensely to the development of Military and Civil aviation, and manned space flight, in terms of the safety and effectiveness of human beings. In this paper I will discuss early activities relating to another anniversary, the 40th anniversary of what is now called the Human Engineering Division of the Aerospace Medical Research Laboratory. On 29 May 1945, HQ Army Air Forces directed the Air Material Command at Wright Field to establish a psychological research facility to study equipment design problems. As a result, there was established, on 1 July 1945, a Psychology Branch of the Aero Medical Laboratory. For convenience, in this paper I will refer to the laboratory by its common abbreviation, AMRL.

My first knowledge about the plans for this new Psychology Branch came just about this time 40 years ago. I was serving as Chief of a Psychological Examining Unit at Keesler Field, Biloxi, MS. This Psychological Examining Unit was part of a large World War II Aviation Psychology Program, under the Office of the Air Surgeon, devoted primarily to the selection and classification of Aircrew Personnel. This news came to me from Dr. Paul M. Fitts (Lt Col), stationed in the Office of the Air Surgeon. He had been selected to head the new venture at Wright Field and invited me to join. The proposed program, pioneering a new field, interested me very much, and I promptly volunteered for assignment to the new Psychology Branch of AMRL.

Most of the initial staffing of the Psychology Branch was by officers and enlisted men from the wartime Aviation Psychology Program, which, during most of the war, was centered in the AAF Training Command. At this time, 40 years ago, the war in Europe had ended, and the war in the Pacific was in its final stages. Thus, the program we were in would obviously be scaled down.

I was one of the first of the staff of the new branch to arrive at AMRL in August 1945. Dr. Fitts arrived a few days later. Soon many others, mostly military, and a few civilian, joined the new branch. We were graciously welcomed by the Laboratory Commander, Dr. William R. Lovelace, III (Colonel). Others in the laboratory also seemed pleased to see us, and made us feel very welcome. At that time most of AMRL was housed in building 29, and four adjoining one-story buildings which are still in place. An animal facility and some hydroponic gardens north of building 29 were removed long ago. Initially space was made available for us in building 29. Rather soon, as a new building was completed for the Engineering and Development Branch, we were able to expand into buildings 196 and 197. Within a few years, we learned of another new building, number 248, to be built for the Physiology Branch, thanks to Dr. Pharo Gagge, who was chief of Operations at that

* Originally written as "The Genesis of Human Engineering" for the occasion of the 50th anniversary of the Air Force Aerospace Medical Research Laboratory. Portions were published in "50 Years of Research on Man in Flight," 1985, Charles A. Dempsey.

time. Two additional floors were added to the plans for building 248, specifically for the Psychology Branch. Building 248 is still the home of the present Human Engineering Division.

With the war drawing to a close, why did the Air Force find it necessary to set up a new and pioneering program of psychological research? For the answer to this question, we have to look at some of the lessons learned from wartime combat operations. One of these lessons, as Dr. Stevens of Harvard University stated, was that "Machines Cannot Fight Alone." A major weakness in many weapon and support systems was the human operator. Far too many aircraft and their crews were lost because of pilot or navigator error. Bombing accuracy fell far short of what the systems should have been capable of delivering. Fire control by fighter aircraft, and flexible gunners, also was disappointing. Although the human operator proved to be a major weakness, it was realized that much of the fault was in the original design of the equipment, which was often poorly matched to the physical and intellectual capabilities of the men and women who had to use it. To overcome this problem much effort had gone into selecting and training the operators, but this was not enough. Research was needed to find designs which were more compatible with human capabilities.

During the war a few of these design problems had been investigated by psychologists. At the Harvard Psychoacoustic Laboratory, for example, research led to significant improvements in the design of radio communication systems. At a number of other places, psychological research efforts were applied to fire control and radar systems. In Great Britain, also, there were some wartime research efforts by psychologists on equipment design problems. The major effort was at Cambridge University, under Sir Frederick Bartlett.

It was not until after the war, however, that a major attack was made on the problems of designing equipment for human operation. At about the same time that the Air Force set up the Psychology Branch, the U.S. Navy set up several new research units with similar missions. These were at the Special Devices Center on Long Island, the Navy Electronics Laboratory at San Diego, and the Naval Research Laboratory at Anacostia, MD. In addition, the Navy initiated a major contract program with Johns Hopkins University to study Combat Information Centers. At this time, also, the Psychological Corporation in New York set up a new group to do contract work on equipment design problems. This group soon split off to become Dunlap and Associates. It was not until about 6 years later that the US Army established a Human Engineering Laboratory at Aberdeen Proving Grounds in Maryland.

At AMRL we first used the label "Engineering Psychology" for our type of activity. Our counterparts in other laboratories, however, began using other labels such as "Human Engineering," "Human Factors," "Human Factors Engineering," and "Biomechanics." Our counterparts in Great Britain used the term "Ergonomics." While all these labels are still in use, in this paper I will use the term "Human Engineering."

For those of us in the new Psychology Branch, coming to AMRL and Wright Field was a very stimulating experience. In the Training Command we were accustomed to marching cadets and training aircraft. We were also quite familiar with the then-current operational aircraft. At AMRL and Wright Field we began learning about the Air Force of the future. At AMRL we learned about partial pressure suits, advanced G suits, atomic flash protectors, and liquid oxygen converters. Being located at Wright Field, we also learned about jet aircraft, rocket engines, transistors, new concepts of air traffic control, new ideas for aircraft cockpits, and many other new areas of aviation development.

We also had much to learn about how to do things the Wright Field way. Here we suddenly became engineers, project engineers, that is. The fact that we were psychologists, and not engineers, did not seem to matter. Research work was organized into projects and tasks. Once a project was established, it went on forever, it seemed. We had to keep data in

Project Record Books, which were periodically inspected to be sure that we did it right. We also learned that most scientists in the laboratory, I mean project engineers, did not really do research. They developed and tested end items, such as new oxygen masks, G suits, partial pressure suits, and sunglasses. The Project Record system at Wright Field was geared to the development of end items, not to research. We had come to do research, and the end items to which our research would have application were the responsibility of other Wright Field laboratories, not AMRL.

Also strange to us was the reporting system we were required to use for publication of our research results. The required type of report was called a Memorandum Report, and was geared strictly to the development and evaluation of end items. It was quite inappropriate in format for the reporting of scientific experiments. Fortunately this situation was only temporary. In a few years a new type of reporting system was introduced, with the use of Technical Reports for major studies, and Technical Notes for studies of lesser scope. These reports were far more suitable for reporting scientific experiments.

Another thing we soon discovered after our arrival at AMRL was money, in this case contract money for the purchase of research equipment and research. In the process of getting our program underway we had to set up new projects and thereby get into the budget cycle for funding in future years. It turned out that other projects in the laboratory had funds surplus to their needs, and we were literally deluged with funds that were transferred to us. Thus, we soon found ourselves hustling to write work statements for research equipment that we needed, and for research that we could farm out to university contractors. We were most fortunate to have this windfall of contract money to help us launch our new program. Amazingly, we were even provided with transfer of funds from other Wright Field laboratories that were anxious to have us supervise research related to their areas of responsibility.

As I mentioned earlier, the initial staffing of the Psychology Branch was mostly officers and airmen from the wartime Aviation Psychology Program. As the war ended, most of these people separated from the Air Force and returned to universities or other civilian occupations. Some of us, including Julien Christensen and Melvin Warrick, converted to Civil Service status and stayed at AMRL. Those who left were soon replaced with other officers and enlisted men, and some civilians. Among the new additions were pilots, navigators, and bombardiers, some of them with no training in psychology. They were, however, most valuable additions to our group because of their personal knowledge of flight operations and flight crew duties. I have a picture of the Psychology Branch staff, taken in 1948 (Figure 1-6). Dr. Fitts, our most inspiring and capable leader, is seated in the center front row. We were all very sad when he left us in 1949 for a position at Ohio State University, although he continued to assist us in many ways after that. We were saddened even more when he passed away suddenly at Ann Arbor, Michigan in 1965.

At the time this picture was taken, a few members were absent and failed to get into the picture. About 10 years after this picture was taken, the Anthropology Section, under Ed Hertzberg, joined our branch. Some years later, also, our mission was expanded, and new personnel added, to include research on training, with special emphasis on design of training devices and equipment. Dr. Gordon Eckstrand headed up this new activity.

Early in our existence, to give proper direction to our research, we began visiting the nearby laboratories whose end items would be the focus of our research. These laboratories were primarily Communication and Navigation (radios, instrument landing systems, and air traffic control), Equipment (aircraft instruments, instrument and cockpit lighting), Aircraft (crew station design and layout), and Armament (radar and fire control systems). After the project engineers in these laboratories understood that we were not there to develop end items in their areas of responsibility (I think this is called turf these days), they were happy to tell us about operator problems they had encountered.

FIGURE 1-6: THE PERSONNEL OF THE AMRL PSYCHOLOGY BRANCH IN 1948
From the left, back row: Lt Wise, Mr. Bakalus, Mr. Gardener, Miss Fuerst, Mr. Roettele, Miss Connell, Mr. Warrick, Mrs. Morris, Mr. Christensen, MSgt Kake, Sgt Edison, and Mr. White Seated in the front row, from left: Capt Jones, Maj Long, Dr. Fitts, Dr. Grether, Dr. Biel, and Capt Wilcox.

They were very receptive to the idea of having us conduct human engineering research applicable to their equipment. From our discussions of these problems with them, we gained many valuable research ideas. For some of the problems they described, we could provide data from the available psychological research literature. They brought up other problems, however, which we saw no way of solving through research we could visualize. We also received some wild proposals, and these we politely rejected. One such proposal came to us in a letter requesting us to supervise a research program on Extra Sensory Perception, as a possible substitute for radio communication. I was quite familiar with research literature in this field, and sent them a diplomatic reply explaining why such research would not be productive.

In this paper, I will briefly describe some of our very early research efforts, and the successes or failures of these in terms of applications to Air Force equipment. Some of these studies were originally reported in Volume 19, of the AAF Aviation Psychology Program Research Reports (4) which the branch had ready for publication in October 1946.

For his effort to educate himself about problems needing research attention,

particular credit must go to Julien Christensen, a former AF navigator. Dr. Christensen (2) arranged to conduct activity analyses of navigators in B-29 aircraft during very long operational-type missions, mostly in the Arctic. This gave him valuable data on how the navigators carried out their duties in our newest operational bomber, how their work time was distributed, and what problems they faced. It also gave Chris membership in the Pole Vaulter's Club, and the right to the claim as the first civilian to fly over the North Pole in an Air Force aircraft. Christensen also conducted research on errors made by navigators in using their standard navigation plotter. His experimental evaluation (3) of several different plotter designs led him to design an improved plotter which became the standard for use in the Air Force. This was the first, and one of the few end items ever developed by the Psychology Branch.

A major problem that had plagued the Air Force during the war, and before, was pilot error as a major cause of aircraft accidents. Statistical data maintained by the Directorate of Flight Safety Research, at Norton AFB, San Bernardino CA, consistently showed that about 75% of major aircraft accidents were attributable to pilot error. It can be argued that many of these were really designers' errors, that trapped the pilots into making what were often fatal mistakes. A very common type of error was activation of the wrong control. At that time each type of aircraft had a different arrangement of controls and instruments in the cockpit. Thus, when a pilot changed from one type of aircraft to another he was very like to reach for the wrong control, or read the wrong instrument. Also, some controls were located in places where they were difficult to reach or to see. This particular source of pilot error was largely eliminated in future aircraft by two major changes in cockpit design: (1) standardized location of major controls and instruments in the cockpit, and (2) shape coding of major cockpit controls. Thus, when a pilot transferred to a different type of aircraft he did not have to relearn the location of major cockpit items, and major controls could be identified by touch alone. These changes were implemented primarily by the Crew Stations Branch of the Aircraft Laboratory, with much technical input from members of the Psychology Branch, using the results of several experiments. One of these experiments, by William Jenkins (10), tested the identifiability by touch alone, among a group of shape-coded control knobs. Figure 1-7 shows the knobs that were included in this experiment. Pilot Dick Jones is shown as the subject. Another experiment, by Fitts and Crannell (5), measured the accuracy with which pilots could reach to possible control locations in the cockpit. An experiment by Mel Warrick (13) determined the preferred relationships between control movements and instrument indications when these were located in different axes or planes in the cockpit. The Anthropology Section (which later transferred to the Psychology Branch) provided very essential data about cockpit sizing to accommodate the full range of pilots' body dimensions.

An important aspect of the cockpit standardization effort was agreement on a standardized arrangement of the six flight instruments, namely the horizon, altitude, air speed, rate of climb, heading, and rate of turn instruments. A major contribution toward agreement on the best arrangement of these instruments came from a pilot eye movement study conducted by Fitts, Jones and Milton (7) in a C-45 aircraft assigned to the branch. This study measured the frequency and pattern of eye movements during different phases of flight.

As already mentioned, pilot error had been a major cause of aircraft accidents. In most cases the pilots could not be interrogated to determine the exact nature of the error, and this could only be deduced from the accident data. One of the first studies conducted in our branch was an interview study by Fitts and Jones (6) in which pilots were asked to recall and describe errors they had made in flight that could have resulted in accidents. Among these were errors in reading instruments. A sample of some of the findings regarding

FIGURE 1-7: CODING AIRCRAFT CONTROL KNOBS
Knobs employed in a study of shapes for use in coding aircraft control knobs. (Capt Richard E. Jones as subject). From Jenkins (10).

instrument reading errors is shown in Table 1-2. You will note that the category with the highest frequency of errors was in reading multirevolution instruments. Mostly these were errors in reading the standard three-pointer altimeter used in most military and civilian aircraft at the time. This finding led me to conduct an experimental study of altimeter reading (8), using nine different types of altitude display that might be suitable for use in aircraft. Both college students and pilots were used as subjects. The results show that this instrument takes a rather long time for reading, and yields a high percentage of reading errors. Unfortunately, many of the reading errors were in the hazardous direction of reading the altitude as higher than it actually was. The most common mistake was to read the altitude as exactly 1,000 feet too high. We believe this type of reading error accounts for a great many unexplained accidents in the past, where aircraft hit mountains just below the peak, or landed just short of the runway on instrument approaches to landing.

Based upon the results of this experiment, I recommended that the altimeter be redesigned to provide a display which uses a single pointer making one revolution for each 1,000 feet change of altitude. An added odometer type of indicator displays thousands and ten-thousands of feet altitude. Both pilots and college students made almost no errors with this display, and reading time was very short. In ensuing years several investigators in other laboratories conducted experiments with similar displays and corroborated these results. Unfortunately, the engineers responsible for altimeter design were unwilling to give up the mechanically reliable three-pointer design. It was not until about 20 years later that the altimeter was changed to provide the greatly improved type of display. The change was then made because a redesigned instrument was needed so that altitude could be automatically transmitted by radio link to the ground, for air traffic control purposes. The improved type of altitude display is now standard in most military and commercial aircraft.

These are a few of what you might call successful outcomes of our early research. Some of our other studies might be of equal interest, even though they did not produce the hoped-for results. As we know, negative results, or results that do not lead to practical applications, can also be of great value.

Late in the war the B-29 was a very important aircraft in our inventory, and it played a key role in ending the war in the Pacific. In this aircraft, at the waist gunner station, was a very advanced type of gun sight known as the pedestal sight. Gunners had considerable difficulty in using this sight, and accuracy was considerably below expectations. We were requested by the Armament

TABLE 1-2

Classification of 270 Errors Made by Aircraft Pilots in Reading Instruments
(Modified from Fitts and Jones, 1947)

Type Error	Percent
Misinterpreting Multi-Revolution Instruments	18%
Misinterpreting Direction of Indicator Movement (Reversal Errors)	17%
Misinterpreting Visual and Auditory Signals	14%
Errors Involving Poor Legibility	14%
Failing to Identify a Display	13%
Using an Inoperative Instrument	9%
Misinterpreting Scale Values	6%
Errors Associated with Illusions	5%
Omitting the Reading of an Instrument	4%

Laboratory to evaluate two sets of redesigned controls for this sight. The original controls, because of their design, caused interference for the operator between the separate tasks of controlling elevation, azimuth, range, and triggering. Also, an undue part of the load was given to the left hand. It was rumored that the designer of the sight was left-handed. An experiment, conducted by Johnson and Milton (11), showed one of the redesigned sets of controls to be clearly superior to the original controls. In this instance, however, no effort was made to install the improved controls in B-29 aircraft, since further combat use of this aircraft seemed unlikely.

As mentioned earlier, our branch had a C-45 aircraft assigned to it, and this was used very successfully for experimentally recording eye movements in flight. This success led us to request a larger aircraft, a C-47, for research on other aspects of pilot performance, with special emphasis on pilot fatigue. A question that we encountered quite often was "How long can a pilot fly safe under instrument conditions?" Past research on fatigue, by others, had generally been disappointing. Although pilot fatigue seems to be a genuine problem, and a serious flight hazard, this condition had been extremely resistant to objective measurement. We had the C-47 aircraft equipped with a remote panel of instruments, for photographic recording of pilot performance. Missions were flown with the pilot under an instrument flying hood. The missions were 14 hours in length, with a refueling stop at midpoint. Detailed analysis of the instrument recordings failed to show a significant decrement during the 14 hour missions. There were, however, subjective indications that the pilots were quite fatigued. One of the pilots, in his hurry to get home and rest, hit another car as he backed out of his parking space.

Another research area to which we gave considerable attention, and some research, was the issue of "Fly To" and "Fly From" on aircraft instruments. Another way of stating the question was, should the moving element of the instrument represent the aircraft (a "Fly From" indication), or should it represent the earth (a "Fly to" indication)? On most instruments the moving element represents the earth. This conflict could be expected to cause habit interference on the part of pilots. Our pilot interview studies referred to earlier showed that pilots frequently made reversal errors in flying the gyro horizon and radio compass. A wartime study by Loucks (12) at the AF School of Aviation Medicine had shown that it was more natural to fly the moving bar

of the gyro horizon as if it were the aircraft, rather than the horizon. Similar results were obtained by Brown (1) in Great Britain. Early in our program we acquired a wartime Link Trainer, and two of our employees, Joe Bakalus and Bob Roetelle, were former Link Trainer operators. With their help, John Gardner, one of our pilots, did a study of methods of horizon display. His results agreed with those of previous studies. A change to the moving aircraft type of display was, however, never seriously considered by the engineers responsible for the design of flight instruments. In retrospect, I think they were probably right. For a rather long time now the standard gyro horizon display has been a stabilized sphere, which can display all possible aircraft attitudes. The moving aircraft type of display, as far as I know, is not amenable to such all-attitude representation.

There was another long-standing idea that engaged some of our early thinking. Actually this was not so much our idea, as that of anthropologists and biophysicists in AMRL. This was the idea that the pilot, in a fighter aircraft, might fly in the prone position, as the Wright brothers did in their first aircraft. This position would give the pilot considerably increased G tolerance, and would also permit a reduced vertical cross section of the aircraft. The Psychology Branch provided some help in testing this idea. Through a contract with the University of California at Berkeley, we had a set of controls constructed for flying in the prone position. Under the auspices of the Anthropology Section a prone position bed, and the controls, were installed in the nose of a B-17 aircraft as a test vehicle. Quite a few of us had a chance to actually fly the B-17 using this novel arrangement. I think even the anthropologists agreed that this position had some serious disadvantages, among them being the difficulty of forward and upward vision. The idea seems to have been laid to rest as a result of this trial.

In this report I have given you a flashback to some of the pioneering research of the Psychology Branch during the first five years of its existence, and I showed how some of these research studies contributed to aviation development. In the ensuing years, the Psychology Branch, later renamed the Human Engineering Division, continued as a leading organization for Human Engineering research. Beginning in the late 1950s, as manned space flight became a possibility, much research of the branch was directed to problems of working under zero-gravity conditions, cycling of work and rest during prolonged confinement, and other problems related to manned flight in space. During some of the same period, as our nation was engaged in the Vietnam War, other research efforts were directed to Limited War types of aviation operations. Major contributions were made in both of these rather different areas. From the modest beginning made by the Psychology Branch, and several parallel research organizations in the US Navy about 40 years ago, Human Engineering has grown into a large and widespread area of applied science. There are now probably several thousand persons employed as Human Engineers in this country, in the Department of Defense, in defense and nondefense industries, consulting firms, and universities. Some of this expansion of Human Engineering was covered in a review I prepared in 1966 (9).

In conclusion I would like to express my personal satisfaction with the 28 years I spent at AMRL. Approximately seven of those years were as Chief of the Psychology Branch, following Dr. Fitts. The remaining years were in various staff positions. I enjoyed my association with the medical and medically related specialists who made up the laboratory. I also enjoyed my close association with development engineers in other Wright Field laboratories.

After 40 years the Human Engineering Division is still a vigorous and productive organization. This is due in large part to the leadership provided by Dr. Julien Christensen, who followed me as Chief, and Charles Bates, the present Chief. It is also testimony to the past history of accomplishments of this organization, and to the administrative support and scientific environment provided by AMRL.

REFERENCES

1. **Brown, R. C.**, (1945). *Comparative trial of two attitude indicators.* Brit. Flying Pers. Res. Comm. Rept. 611a.

2. **Christensen, J. M.**, (1947). Psychological factors involved in the design of air navigation plotters. Chapter 5 in P. M. Fitts (Ed.) *Psychological research on equipment design. Washington D.C.: US Government Printing Office, (Vol. 19, AF Aviation Psychology Program).*

3. **Christensen, J. M.**, (1949). A method for the analysis of complex activities and its application to the job of the Arctic aerial navigator. *Mechanical Engineering, 71*

4. **Fitts P. M.** (Ed.), (1947). Psychological research on equipment design. *Washington, D.C.: US Government Printing Office, (Vol. 19, AF Aviation Psychology Program).*

5. **Fitts, P. M., and C. Crannell**, (1950). *Location discrimination. II. Accuracy of reaching movements to twenty-four different areas.* USAF Air Material Command Technical Report 5833.

6. **Fitts, P. M., and R. E. Jones**, (1947). *Psychological aspects of instrument display. I. Analysis of 270 "pilot-error" experiences in reading and interpreting instruments.* USAF Air Materiel Command Mem. Report TSEAA-694-12A.

7. **Fitts, P. M., R. E. Jones, and J. L. Milton**, (1950). Eye movements of aircraft pilots during instrument landing approaches. *Aerospace Engineering Review 9.*

8. **Grether, W. F.**, (1949). Instrument Reading. I. The design of long-scale indicators for speed and accuracy of quantitative readings. *J. Appl. Psychol. 33(4).*

9. **Grether, W. F.**, (1968). Engineering Psychology in the United States. *American Psychol. 23(10).*

10. **Jenkins, W. O.**, (1947). Tactical discrimination of shapes for coding aircraft-type controls. In P. M. Fitts (Ed.), *Psychological research on equipment design. Washington, D.C.: US Government Printing Office, (Vol. 19, AF Aviation Psychology Program).*

11. **Johnson, A. P. and J. L. Milton,** (1947). An experimental comparison of the accuracy of sighting and triggering with three types of gun-sight handgrip controls. In P. M. Fitts (Ed.), *Psychological research on equipment design. Washington, D.C.: US Government Printing Office, (Vol. 19, AF Aviation Psychology Program).*

12. **Loucks, R. B.**, (1947). An experimental evaluation of the interpretability of various types of aircraft attitude indicators. In P. M. Fitts (Ed.), *Psychological research on equipment design. Washington, D.C.: US Government Printing Office, (Vol. 19, AF Aviation Psychology Program).*

13. **Warrick, M. J.**, (1947). Direction of movement in the use of control knobs to position visual indicators. Chapter 9 in P. M. Fitts (Ed.), *Psychological research on equipment design. Washington, D.C.: US Government Printing Office, (Vol. 19, AF Aviation Psychology Program).*

FITTS HUMAN ENGINEERING DIVISION: 1985-PRESENT

A. INTRODUCTION

During the last ten years, the Human Engineering Division of the Armstrong Laboratory has been very productive in many areas. In appraising just how productive the division has been during these years, it is important to keep in mind that the division is a research and development (R&D) organization with two products or outputs: its publications and its direct assistance to organizations that develop, evaluate, and use man-machine systems. The division conducts both laboratory and field studies to collect data on the physical and mental abilities of people for use in designing, developing, and applying man-machine systems. These data allow tailoring of equipment to fit its users so that man-machine systems fully utilize the abilities of both the equipment and its users.

A cursory examination of the entries in the bibliography over the last ten-year period reveals that, during this period, the Human Engineering Division was a prolific publisher of journal articles and technical reports. However, it should be noted that the bibliography does not fully reveal the extent of direct assistance and development work by the division, since an appreciable part of the development work had security classifications that prevent inclusion in this volume. The authors of this document readily admit that not all research and development conducted in the Human Engineering Division is represented in this work. Because of classification, sensitivity, expediency, or oversight, the work of many talented researchers was unfairly underrepresented or omitted altogether. In those cases, we beg your indulgence. We felt that complete representation was not practical and, in fact, not desirable. Our goal was the inclusion of a broad, representative set of topics illustrating the major activities of the organization and the time. Again, our apologies to those whose work has been slighted.

During the last ten years, much of the research and development work of the Human Engineering Division on specific topics and problems was continued from previous years, because many of the problems required still better solutions. In some cases, changes made in systems under investigation required new human engineering inputs for evaluation. In some cases, new problems surfaced during use of new systems. In the relatively short span of the last ten years, the advance of technology has caused significant changes in both the equipment used by the armed forces and in laboratory equipment. The constant pressure to increase operational effectiveness and maintainability while decreasing lifetime cost of ownership of aircraft and space vehicles was accompanied by changes in their displays, controls, operating procedures, and combat tactics. Changes were usually in the direction of increased complexity and were not always effective.

Increased use of computers is one factor influencing division work. Although digital computers have been around for several years, in the last ten years there has been an appreciable increase in the number of computers and output media in offices, laboratories, and military systems. There has also been a large increase in the percentage of laboratory and operational equipment having digital indicators and displays, with digital devices in many cases replacing analog devices. Instruments for measuring many quantities, such as the amount of fuel in a tank, aircraft speed, weight, dimensions of parts of the human body, strength, etc., are now automatically converted at the measuring device to digital form for display and for storage in computer memory. Increasingly, the process of collecting data bypasses the need to read numerical values and manually record them by writing or keyboard use. Once

in the computer, statistical data analysis programs allow computers to perform any desired statistical calculations, provide tables of numerical values, and draw graphs, charts, and complex illustrations. The technical reports on the results of research and development efforts are now written with the aid of word processors, frequently by the engineers and scientists using their own computers.

To illustrate the effect of the digital revolution on the work of the Human Engineering Division, in 1988 the division's physical anthropologists acquired a computer-controlled laser scanner that automatically measured the three-dimensional (3-D) coordinates of human heads and recorded the data in computer memory. The computer data have been used to automatically control a milling machine that turns a block of material into a replica of the scanned head. Within a brief time after a subject is scanned, a 3-D solid replica of the head is available. Formerly, several days to weeks were required. The scanner greatly increases the ability of the division to collect survey data for designing or evaluating helmets and head-carried equipment, such as oxygen masks and night vision goggles.

There is still plenty of work to be done; as technology advances, new problems will occur and old ones will require better solutions. Hence, human engineering must also advance. The Human Engineering Division has an important role in this advancement, and is looking forward to the next 50 years of human engineering.

B. SCIENCE & TECHNOLOGY PROGRAMS

1. Human-System Performance Research

Performance and Workload Assessment

This research and development activity was directed toward generating subjective, behavioral, and physiological metrics and measurement methods for evaluating operator workload, situation awareness, and decision making in Air Force systems. This research has had two principal foci: workload and situation awareness measurement. These two areas can be thought of as representing attempts to quantify the demands placed on a system operator compared to his/her ability to accommodate the demand in performing the mission (workload) and quantifying or characterizing the quality of the information processing while the operator is performing his/her mission (situation awareness). The tools developed during this period have played an important role in comparing alternative interface designs and establishing the viability of a specific design for achieving mission requirements.

In June of 1979, the Workload and Ergonomics Branch was formed to address a growing concern of Air Force operators and planners about the information processing demands being placed on systems operators of emerging high-technology systems. The Branch Chief, Maj Robert O'Donnell, assembled a team of government scientists, contractors, and academic researchers to pursue a three-pronged research program to develop metrics of human mental workload. The act of organizing a branch around a technical problem, in and of itself, was unique. Typically, human factors organizations are organized around generic, operationally oriented factors such as controls, displays, or training.

Mental workload became a very hot research topic in universities and government laboratories around the world. Additionally, the problem of information in aircraft cockpits became so widely acknowledged that, in 1979, the Commander of Air Force Systems Command, General Alton Slay, proclaimed it as one of the Air Force's most pressing problems. He mandated that all new aircraft designs should take pilot workload into consideration.

Emerging technology increased operator workload in several ways. Expanded system capabilities, with a concomitant increase of displayed information, created unprecedented demands on operator attention and resources. Secondly, advances in automation technology led managers to believe that complex flight

tasks could be performed with smaller crews, since large components of the tasks could be turned over to machines. This combination of events dramatically changed the nature of cockpit tasks. The push to reduce crew size was also taken up in the private sector by the airlines. When the Boeing 757 was being prepared for certification, there was a push to certify the aircraft for a two-man crew. Due to the critical nature of the issues involving many components of national interest, President Reagan formed a special Presidential Advisory Commission on Aircraft Crew Complement. Lt Col Robert O'Donnell was named as a staff member for the commission and played a very active role in producing the commission's report.

Generally, research in mental workload took one of three approaches: subjective measures, behavioral or performance measures, and physiological measures. Behavioral approaches, especially secondary task methodology, helped to define the construct of mental workload as multi-dimensional and, in some way, related to the allocation of mental resources among tasks. Subjective approaches were believed to be the most widely used, especially in operational testing. Few could argue that some method of having people estimate how hard they were working was a necessary part of studying workload. Other measurement methods ultimately have to pass the test of corresponding with what the operator believes to be true. Finally, physiological measures have had a great deal of appeal as objective ways to reflect how hard the organism is working. Academic research at the time, especially by Dr. E. Donchin at University of Illinois, focused on evoked cortical response that could be shown to have a relationship to cognitive activity. The implications for measuring workload were unavoidable.

Research, especially in the areas of behavioral models and physiological phenomena, was widespread. However, the Workload and Ergonomics Branch was the only place where all three approaches were brought together into a unified program where they could be used to complement each other in the investigation of this complex construct.

Behavioral/Performance Measures: This work was heavily influenced by the research of Dr. Christopher Wickens, of the University of Illinois, who authored a multiple resources model of human information processing. Dr. Clark Shingledecker and Dr. Thomas Eggemeier, members of the newly formed branch, explored the use of secondary task methodology. Eggemeier's work included development of a conceptual framework for mental workload that was the theoretical basis for the entire branch research program. Dr. Shingledecker explored ways to use naturally occurring task components as if they were laboratory secondary tasks and, thus, developed a methodology known as Embedded Secondary Tasks. He also studied the use of other non-intrusive tasks, such as rhythmic tapping, as indices of primary task load.

Dr. Shingledecker led a team that developed the Criterion Task Set (CTS) and released it for general use in 1984. The CTS was a unique task battery based on a model of information processing. The idea behind the battery was to develop a series of tasks that would tap specific mental resources. The goal of the task battery was to provide a standard test battery to use in evaluation and validation of proposed workload measures. This task battery work then expanded, and Dr. Shingledecker was asked to participate in a Tri-Services Working Group, chaired by Dr. Fred Hegge of Walter Reed Army Medical Center, assigned to develop a task battery for use in screening chemical defense drugs. Drugs that were being developed to counteract potential weapons often have undesirable performance effects. The Unified Tri-Services Cognitive Performance Assessment Battery (UTC PAB) was developed and extensively tested here and under contract with the University of Oklahoma.

Work on the UTC PAB spawned international interest in development of a standardized performance battery and procedures. An AFOSR-sponsored meeting hosted by A. N. Sanders at the University of Aachen, Germany was held and an AGARD working group was formed to direct the battery development. Lt Col O'Donnell presided over

the Aachen meeting where Dr. G. Santucci of CERMA, Paris, France was selected as the permanent chairperson. Dr. Glenn Wilson became the Workload and Ergonomics Branch representative and the NATO/STRES (Standardized Tests for Research on Environmental Stressors) was developed. The purpose of this battery was to provide the international research community with an agreed upon, standardized group of tasks and procedures to promote exchange of information and data on human performance limitations.

Physiological Measures: The work by Drs. Donchin and Wickens on the cortical evoked response was the starting point for the development of physiological measures. From the very beginning, the objective was to package a state-of-the-art physiological test battery that could be used in research on mental workload and in Air Force tests measuring mental workload. The battery was unique in that it included the cortical evoked response, steady state evoked response, brain-stem evoked response, several heart rate measures, electromyographic measures, respiration, and eye movement. The first battery was called the Neuropsychological Workload Test Battery (NWTB) and was unique in that it had test procedures, data collection capabilities, and data analysis capabilities combined in one device. These devices were delivered to other researchers in England, the National Drug Institute, Boeing, Northrop, and the Navy.

A major spinoff of this work was the development of a clinical evoked potential laboratory in association with the Wright-Patterson AFB Medical Center, where cortical and brain-stem evoked responses were used for audiometric and vision testing in difficult cases such as premature infants and multiple sclerosis patients. These techniques have now become standard clinical practice. Col O'Donnell also consulted with Miami Valley Hospital where a similar facility was developed.

A significant basic research program resulted in the first DOD magnetoencephalography (MEG) laboratory. The MEG work was based on the work of Dr. Lloyd Kaufman (New York University) and others, who had made significant progress in using measurement of magnetic fields to localize origins of electrical activity associated with cognitive activity. This basic research program was used to elucidate the brain activity associated with cognitive activity and to supplement EEG approaches. The facility was developed by Lt Col Charles Hatsell, M.D. and has provided a fertile research area for cooperative research with AFIT graduate students and visiting scientists from Europe.

Dr. Glenn Wilson took over the physiology laboratory when Col O'Donnell retired and has extended the laboratory work of O'Donnell into flight. In 1981, he was the first person to actually record evoked potentials in flight. The current test battery, the Psychophysiological Assessment Test System (PATS), was built upon the work of two generations of NWTBs. PATS has refined the tests and measures that are available, increased the number of data recording channels, and greatly enhanced the user interface. Another device, the Workload Assessment Monitor (WAM), was developed in 1994 as a portable data collection and measurement device. While there are many portable recorders available, the WAM is the first device with built-in, real-time measurement capabilities.

In addition to the evoked potential work, Dr. Wilson accelerated the development of peripheral measures, such as heart rate, heart rate variability, and eye movements for in-flight workload measurement. In addition to his research flights at Wright-Patterson and surrounding bases, Dr. Wilson consulted with test teams at Air Force Operational Test and Evaluation Center (AFOTEC) and AF Flight Test Center (AFFTC) and has been instrumental in having some of these techniques used in test programs with the B-1B and C-17 aircraft.

Subjective Measures: When the Workload and Ergonomics Branch was formed, it was widely accepted that subjective measures were the primary workload evaluation techniques in

use. It was soon discovered, though, that while subjective approaches were often used, they generally were designed specifically for a given test, and were often modifications of techniques designed for evaluating other phenomena, such as aircraft handling qualities. There was no systematically developed and evaluated measurement system. Using Dr. Eggemeier's Conceptual Framework for Workload, an operational definition of mental workload was developed as a multi-dimensional construct. Dr. Thomas Nygren, from The Ohio State University, helped develop a conjoint analysis mathematical approach to developing a mental workload rating scale (1981). Dr. Gary Reid led the team through an extensive program of evaluation (1982-1985) to establish the measurement qualities and procedures, and refine the Subjective Workload Assessment Technique (SWAT) (Figure 1-8). SWAT was the first thoroughly developed and validated workload measurement approach, and is still one of the most widely used workload assessment approaches. Reid has been instrumental in applying SWAT in a large number of flight and simulator environments and has consulted extensively with the Air Force Flight Test Center and the Air Force Operational Test and Evaluation Center where SWAT is the standard workload measurement technique. Additionally, SWAT has been internationally accepted. Reid consulted with both the French Air Force and the German Air Force for translations of SWAT into French and German language versions.

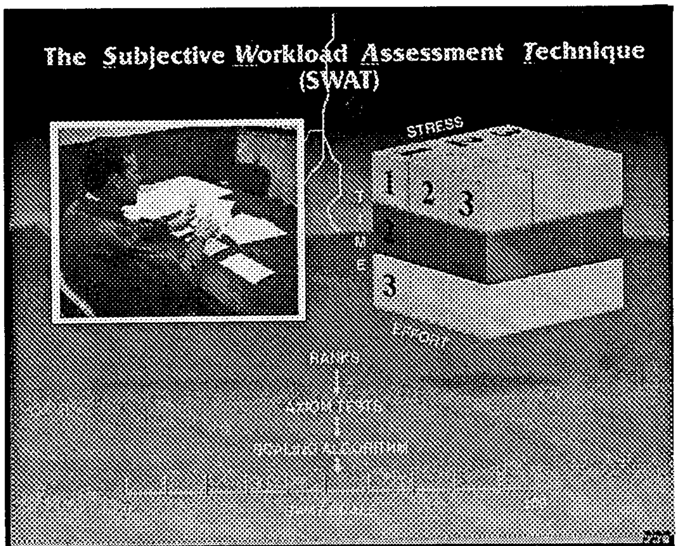


FIGURE 1-8: SUBJECTIVE WORKLOAD ASSESSMENT TECHNIQUE (SWAT)
The SWAT was the first subjective workload metric developed at the lab. It has been widely used in the AF and throughout the world. (Project 718414)

Another subjective measure of workload is the Subjective Workload Dominance (SWORD) technique (Figure 1-9) which capitalizes on the ability of subject matter experts to make relative judgments about differences in workload. This retrospective technique has proven highly reliable and useful for establishing causes for high workload in operational settings. SWAT and SWORD are frequently used in unison to provide a more complete evaluation of operational systems.

In 1993, Drs. Gary Reid and Mike Vidulich provided support to a Wright Laboratory Technology Demonstration Program (Quiet Knight II) flight test. The Quiet Knight II system was designed to make dramatic changes to the way an aircrew will perform their duties for a low-level, night-penetration mission. The purpose of the crew workload evaluation in this test program was to give an early indication of the impact of the proposed system design and task distribution on crew workload. Two subjective measurement techniques were employed: SWAT and SWORD. In general, the test demonstrated that the Quiet Knight II performs the missions

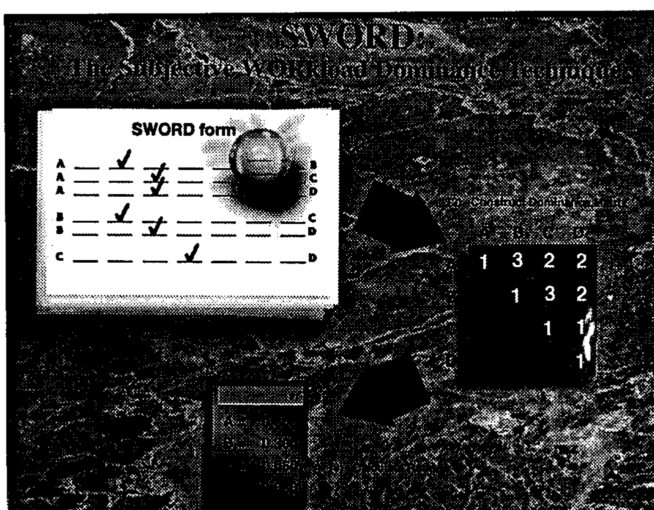


FIGURE 1-9: SUBJECTIVE WORKLOAD DOMINANCE (SWORD) TECHNIQUE
The SWORD technique is a more recent tool developed to complement SWAT in human interface evaluations. (Task 718414)

very well, and crew workload is maintained at a highly acceptable level.

Basic Visual Performance

The basic vision research program under Dr. Mark Cannon has received continuing support from the Air Force Office of Scientific Research (AFOSR) for the past 10 years. When most visual researchers were concerned primarily with measuring thresholds for detection and discrimination, this program pioneered the use of contrast scaling techniques to investigate how the appearance of targets changed with contrast. Investigations were performed for both central and peripheral vision, demonstrating that the spatial frequency pass band characteristics of the human visual system, determined from threshold experiments, did not transfer into the realm of normal everyday suprathreshold vision. These experiments were followed by development of a quantitative model of spatial pattern processing in the human visual system that could predict both the detection thresholds and suprathreshold perceived contrast of spatially localized targets presented on a uniform background. The development of this model earned Dr. Cannon a share of the US Air Force Basic Research Award in 1991. As expected, subsequent research revealed shortcomings in the model. These are being addressed by current research into the effects of background texture on the appearance of a target. Experiments have shown that background texture, similar to the target's internal structure, can produce significant changes in the perceived contrast and threshold of the target. This effect has been successfully modeled as divisive lateral inhibition and will be incorporated into the earlier visual model. The rationale behind the continuing development of this model is that its structure, consisting of parallel spatial filters and non-linear transducer functions, is something that can be easily understood by display and sensor design engineers. A fully developed model will make an ideal tool to evaluate display and sensor designs for image quality and target detection capability while it is still in the planning stage. A current reorganization of the lab will offer greater opportunities to apply the results from this basic vision research to display development programs. The research program has produced two book chapters, many articles in peer reviewed journals, many presentations at vision conferences, and several invited lectures at conferences devoted to display technology. Journal articles published under this program are highly referenced in the vision literature. The laboratory has hosted several scientists under AFOSR-sponsored programs.

Camouflage, Concealment, Deception and Obscuration (CCDO)

The Camouflage, Concealment, Deception and Obscuration (CCDO) Program, initiated by Capt Mike Tutin, Dr. Lee Task, and Mr. Bill Kama, and continued by Capt Mike Dowler and Ms. Denise Wilson, with considerable support by SRL and SAIC, developed and evaluated techniques and devices to increase aircraft and airbase survivability by reducing their detectability. The objectives were to simulate and model air-to-ground visual target acquisition of US and allied airbase assets for development, design, and evaluation of masking and camouflage patterns. Working closely with the Air Staff, AL personnel assisted in drafting an Air Force Regulation for Tactical Deception. The program led to the development and test of low-cost but highly effective aircraft decoys. The AL team also participated in a series of CONUS and OCONUS field exercises directed at quantifying the vulnerability of US and NATO airbases and the effectiveness of decoys, tonedown painting, and other vulnerability reduction techniques (Figure 1-10).

Experimental Man-in-Space (EXMIS)

In the early 1980s, the US Air Force was directed to participate with NASA in the Space Transportation System (STS) Program, otherwise known as the Space Shuttle. This meant that some shuttle launches would be designated DOD and would be partially classified to accommodate the launch of military satellites. As part of this activity, the Military Man-In-Space (MMIS) Program

FIGURE 1-10: DEVELOPMENT AND TEST OF AIRCRAFT DECOYS
Development and evaluation of low-cost aircraft decoys and other countermeasures to visual target acquisition have contributed to the Air Force Airbase Operability Program. (Task 689301)

solicited for secondary experiments to be conducted aboard these DOD shuttle missions. Dr. Lee Task and Lt Col Lou Genco proposed a series of vision studies involving both in-cabin equipment and out-cabin viewing. The vision studies proposed were an extension of the studies conducted by S. Q. Duntley during the 1960s on the Gemini program. These studies were based on some astronauts' contentions that their vision changed (some improved, some degraded) while in orbit. This led to the development of three different types of visual function testers (VFTs) conceived by Dr. Task and Lt Col Genco. VFT-1 was designed to be a self-administered, battery-operated test of visual acuity (far vision), stereopsis, eye muscle balance (vertical, horizontal, and cyclophoria), and eye dominance. VFT-1 flew on a total of eight shuttles, with data collected on 30 astronauts over a period of seven years. Lt Col Mel O'Neal joined the group during this period and was responsible for manifesting the device and collecting the data during the later series of VFT-1 flights. These data demonstrated that there were no overall group changes to vision due to space flight conditions for the visual functions studied, but there were some interestingly significant individual changes, especially in stereopsis, for two of the astronauts studied. VFT-2 was designed to test the visual contrast threshold (contrast sensitivity) of the astronauts' vision to determine whether or not Soviet claims to "significant degradation" of contrast sensitivity during short-term space flight could be substantiated. VFT-2 flew on six shuttle flights with the data collected on 14 astronauts demonstrating that there were no significant group changes in contrast sensitivity due to space flight. The VFT-2 series was conducted by Lt Col O'Neal and Dr. Lee Task over a seven-year period ending in late 1992.

VFT-3 was intended to be a color vision testing device to explore astronauts' comments regarding apparent changes in their color vision while in orbit. However, the requirements for the device to be self-administered, sufficiently accurate to assess small changes in color vision, battery powered, and space qualified proved too difficult, resulting in the abandonment of the device in the late 1980s.

VFT-4, the final vision testing device in this series, was designed to investigate the changes in visual near and far points and speed of visual accommodation (focusing) due to microgravity. This vision test was inspired by some astronauts' stories that they had difficulty reading in orbit and had to use their reading glasses, whereas they used their reading glasses optionally while on Earth. Lt Col Gerald Gleason was the primary force in getting VFT-4 manifested for flight on STS 59 during April of 1994 for its maiden space flight. It is hoped that data will eventually be obtained on a total of ten astronauts before concluding VFT-4 flights and this series of vision tests.

In the late 1980s, the Military Man-In-Space program became interested in the previously rejected out-cabin vision experiments. This led to the development of SpaDVOS (Spaceborne Direct View Optical System) which was basically a six-to-one zoom telescope that could be mounted to the aft flight deck overhead windows for convenience in steering the telescope. In addition, SpaDVOS provided a cueing display to help

FIGURE 1-11: ENGINEERING RESEARCH SIMULATOR
Concept demonstrations of advanced controls and displays are evaluated in multi-operator environment. (Workunit 71841045)

steer astronauts to specific pre-planned points of interest. Several people worked on the development of SpaDVOS, including Dr. Lee Task, Capt Harold Merkel, Capt Jim Whiteley, 1st Lt Pete LaPuma, Capt Scott Hoskins (from HSC), and a multitude of personnel from the University of Dayton Research Institute and Systems Research Laboratories. SpaDVOS was flown on two shuttle missions. During the first mission it was manually steered, and, on the second, it was upgraded to a motorized steering mode. The objective was to compare the level of visual information extraction possible through the telescope with the visual performance of the observers as measured by VFT-1. There was also interest in simply determining what level of visual information could be extracted in this manner in a real-time fashion. The results indicated the biggest problem limiting visual information extraction was the stability of the imagery due to difficulty in smooth tracking.

B-52/B-1/B-2 Systems Integration and Design Evaluation

As mission requirements change, and with the advent of new technologies, changes to existing weapon systems and addition of new subsystems are necessary to implement new mission capabilities. In the traditional crew system design process, the operator has been treated as a slack variable which could be exploited to overcome deficiencies in design. In today's complex weapon systems, it is imperative that the operator, as a subsystem, be considered explicitly on an equivalent level with, and developed concurrently with, other subsystems (avionics).

The Crew Station Integration Branch of the Human Engineering Division has pursued a research program seeking to balance the development of human systems integration assessment technologies with their applications to real-world problems. Drawing on the operational and scientific and technical expertise of a series of military branch chiefs [Maj Lonnie Roberts (B-52 Pilot), Lt Col William Marshak (Psychologist), Lt Col Michael Eller (B-52 Radar Navigator), and Lt Col James LaSalvia (B-1B Offensive Systems Officer)], the branch has strived to combine a high degree of operational relevance with valid human engineering practices. Two major forces that have impacted the branch's research and development program are reduction in crew size (from the six-place B-52, to the four-place B-1B, to the two-place B-2) and evolution of systems-of-systems architecture by the warfighters (Figure 1-11).

Beginning with a two-place defensive station, made up of an Electronic Warfare Officer and Gunner, the conversion of surplus training assets into highly flexible research simulation facilities was successfully demonstrated by Earl Sharp. This approach preserves the accuracy of display and control arrangement and feel, while facilitating integrated performance and workload measurements. Simulation facilities for the B-52, the B-1B, and the B-2 aircraft were developed and employed by Earl, Brad Purvis,

Gil Kuperman, and other branch members in support of emerging operational requirements. These facilities were complemented by the development of the Strategic Avionics Battle management Evaluation and Research (SABER) simulation facility, which was specifically built to support exploratory development. SABER, conceived and guided by Gil and Denise Wilson, is unique in that it can be used to simulate a generic, multi-place aircraft (bomber, tanker, transport, gunship) or, with a different software load, can support exploration of Battle Management/Command, Control, Computers, Communications, and Intelligence (BMC4I) decision-making functions.

The branch research program has explored the impacts on crews of integrating advanced avionics into existing and maturing aircraft platforms (led by the above individuals and 1st Lt Mike Stratton, Maj Ed Fix, Capt Marie Gomes, Dr. June Skelly, Dr. Mike McNeese, Capt Stu Turner, Capt Scott Smith, 1st Lt Lawrie Hamacher, and 1st Lt Stephanie Lind), the human-centered design issues associated with a surviving/enduring mobile command post (Denise Wilson), and the validation of conceptual human-system integration designs (Brad, Earl, Gil, Scott, and Stu). The Crew Station Integration Branch has been highly successful in application research based on a simulate-before-you-fly risk and cost reduction philosophy. Laboratory research has been complemented by the active participation of branch personnel in field and flight demonstrations. These projects include the investigation of night vision goggles for the B-52 and B-1B aircraft, the integration of night vision sensors and target cuers for navigation and target acquisition aiding, and the investigation of crew/vehicle interface requirements for a single-stage-to-orbit hypersonic spaceplane.

The recent research emphasis in the Crew Station Integration Branch is on exploring the impact on crews caused by integration into the manned bomber fleet of gravity and precision-guided conventional weapons, the integration of on-board mission management avionics, and the integration of real-time intelligence into the cockpit capabilities. Innovative research paradigms are currently being developed which tightly couple rapid prototyping technologies to man-in-the-loop capabilities.

2. Design Tools, Methods & Technologies

The Human Engineering Division studies human adaptation to increasingly severe operational challenges and develops databases, methodologies, tools, and standards to help system designers take maximum advantage of human capabilities and limitations in the design and evaluation of complex human-systems. This includes data concerning perception, human performance, and the multi-dimensional size, shape, strength, and functional characteristics of humans. The objective of this activity has been to assist the acquisition community in the design, specification, and testing of Air Force weapons systems. The approach, described in more detail below, has been to provide information for design engineers that permits them to integrate human operators into systems in a manner that will maximize total system effectiveness.

Integrated Perceptual Information for Designers

Reliable data on human ability to acquire and process task-critical information is of prime importance to the design of effective human-system interfaces. While the research literature contains an immense volume of pertinent data, it has not been systematically considered in the typical design of human-systems. Though the nature and availability of these data are a key part of this problem, this lack of utilization can also be attributed to the basic skills and inclinations of designers, limitations in the available support environment, and constraints imposed by the design and acquisition processes. Beginning in 1980, a series of US/NATO AGARD-supported efforts directed by Dr. Kenneth R. Boff were initiated to aid the use of ergonomics data in system design. The goals of these efforts have been to (1) identify and

consolidate ergonomics data of potential value; (2) "human engineer" the representation of these data to enable their effective use by designers; (3) sponsor training to sensitize designers to the value and application of ergonomics; and (4) develop media options for aiding designers in the access, interpretation, and application of ergonomics data. These efforts at understanding and remediating problems in the transition of ergonomic research to applications have since coalesced into a new model for the communication of ergonomics data to practitioners, educators, and researchers. These efforts are summarized below.

Handbook of Perception and Human Performance: Attempting to use the research literature can be a formidable task. This is due, in part, to difficulties in retrieving and interpreting specialized data from the multitude of information sources distributed widely over a variety of report media. The first effort was to identify, collect, and consolidate performance data into a primary reference—the *Handbook of Perception and Human Performance* edited by Boff, Kaufman, and Thomas and published by John Wiley and Sons in early 1986. For this effort, a team was assembled made up of more than 60 recognized experts in 45 subareas of sensation, perception, information processing, and human performance.

Engineering Data Compendium: The objective of this effort was to speed up the transfer of human performance data to the designers of complex human-operated systems. The target users were system designers with little prior training and experience with ergonomics but with a need for reliable data to resolve trade-offs between equipment requirements and human performance capabilities. The product of this effort was a reference document, the *Engineering Data Compendium,* edited by Kenneth Boff and Janet Lincoln and published jointly by AAMRL and NATO in 1988. The Compendium provides comprehensive information on human capabilities and limitations, with special emphasis on those variables which affect the human's ability to acquire, process, and make effective use of task-critical information. Information was selected for inclusion into the Compendium on the basis of its practical potential for system design through an iterative process of review and analysis employing hundreds of subject matter experts and design professionals. Prospective entries were reviewed on the basis of statistical and methodological reliability, applicability to the normal adult population, and potential relevance to design problems.

Ergonomics in Design Short Course: A series of specially designed short courses and workshops were conducted with the goal of providing design professionals with strategies for the use of ergonomics data. These courses were designed around hypothetical, but realistic, human-system design problems which the individual lecturers and student teams systematically addressed in a workshop format. In 1986, this course was successfully offered overseas in Lisbon, Portugal; Athens, Greece; and Delft, Netherlands under the sponsorship of NATO AGARD.

Crew System Ergonomics Information Analysis Center (CSERIAC): In 1988, CSERIAC was established at Wright-Patterson Air Force Base, operated by the University of Dayton Research Institute, and managed by the Fitts Human Engineering Division. Crew system ergonomics information focuses on human and equipment characteristics that either enhance and support, or degrade and debilitate, human performance and well-being in complex tasks and activities. Over the past seven years, CSERIAC has actively supported research, design, and development of complex human-operated systems through on-call analysis and evaluation of ergonomics data and technology. Additionally, it has successfully accelerated the transfer of behavioral, biomedical, and engineering research to practical applications in the private and public sectors. It is presently under the expert administrative management of Dr. Lew Hann and Miss Tanya Ellifritt.

Computer-Aided Systems Human Engineering: Over a decade of research and development aimed at understanding and remediating problems in the transition of ergonomic data and models to application in the design of complex human-operated systems eventually coalesced into a new model of Computer-Aided Systems Human Engineering:Performance Visualization System (CASHE:PVS). CASHE:PVS version 1.0 was developed as a multimedia ergonomics database on CD-ROM for Apple Macintosh computers for use by human-system designers, educators, and researchers. Co-developed by a consortium of US Government agencies and NATO AGARD and managed by Donald Monk, it allows users to rapidly access ergonomics data and models stored electronically as text, tables, graphics, and audio. It contains a hypertext version of the Boff & Lincoln (1988) *Engineering Data Compendium*, MIL-STD-1472D, and a unique, interactive simulation capability: the Perception & Performance Prototyper (P3). P3 aids users in interpreting and applying ergonomics to their specific problems by enabling them to manipulate and directly experience alternative representations of the conditional variables associated with the archived data. The CASHE:PVS CD also features the state-of-the-art in information retrieval, browsing, and navigation (Figure 1-12).

Anthropometric Modeling

The performance of Air Force aircrew members and support personnel is directly influenced by the man-machine interface. To optimize this interface, highly accurate anthropometry is required to define the shape and contour of the human body. As the Air Force's sole source of expertise in anthropometry, the Human Engineering Division provides state-of-the-art measuring techniques and novel statistical methods which optimize the integration of Air Force equipment and weapon systems to the human.

COMBIMAN is an interactive 3-D ergonomic computer graphics model of a human seated at a work station. It models male and female physical characteristics and was developed in the Human Engineering Division as an engineering tool for evaluating capabilities and spatial accommodation of the operator. In 1978, it was first transferred to aerospace industries. By 1994, much progress had occurred in COMBIMAN technology, and development commenced on creating a Virtual COMBIMAN that places a display viewer inside a 3-D cockpit drawing during vehicle landings. Thus, virtual COMBIMAN (Figure 1-13) is an application of virtual reality technology.

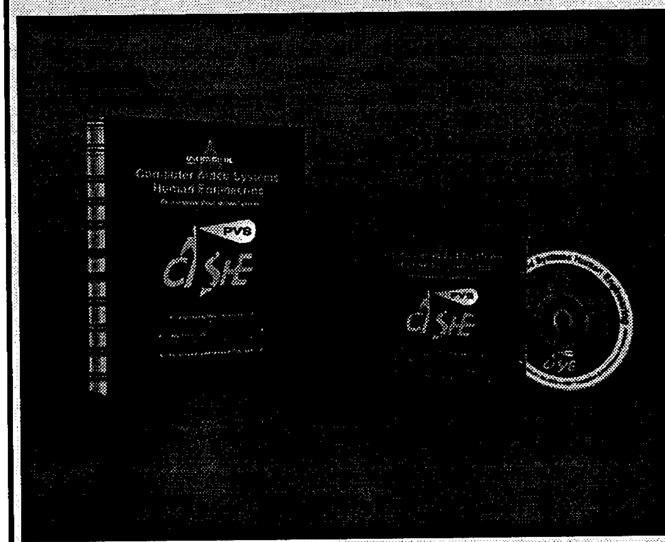


FIGURE 1-12: CASHE:PVS

The ergonomics design tool, CASHE:PVS, integrates interactive testbenches, audio, and animations, with text, tables, and illustrations so that designers can explore and experience the perception and performance data which are described in its reference documents. (Task 718412)

The development of CREW CHIEF (Figure 1-14), another expert anthropometric computer model and ergonomic engineering tool, this time for a maintenance technician, began in the division in 1984 in collaboration with the AF Human Resources Laboratory. An interactive 3-D computer-aided design (CAD) human-model of an aircraft maintenance technician, CREW CHIEF was developed by Dr. Joe W. McDaniel for use by aerospace manufacturers in designing crew station configuration. CREW CHIEF was interfaced with industry computer-aided design systems and, in 1988, it began to be widely used in the aerospace industry to evaluate equipment maintainability.

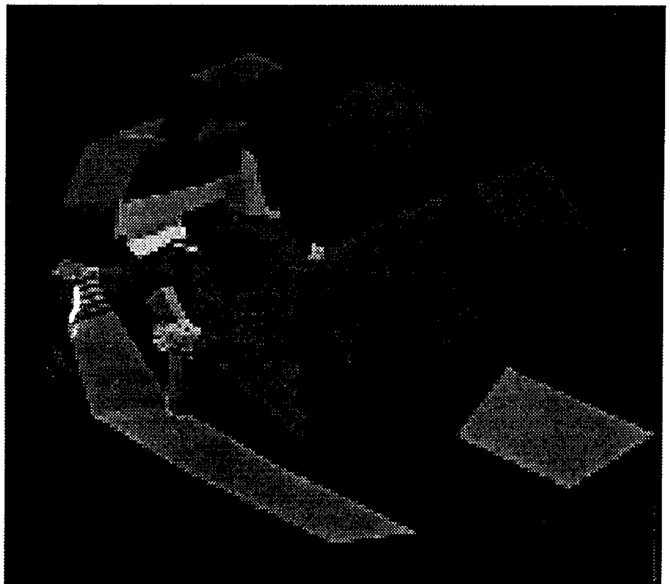


FIGURE 1-13: COMBIMAN
COMBIMAN creates a 3-D human model (male or female) together with six types of clothing, personal protective equipment, and three types of harness restraints . The user has full control over the size and proportion of the model, together with several computer-aided methods. Methods for incorporating the multivariate test sets, described above, are just one of many ways to dimension the model. Built in are models of male and female USAF pilots, non-pilots, and male and female Army pilots, per the latest 1988 survey. Strength analysis includes stick, wheel, lever, pedal, and ejection controls. Reach analyses consider clothing and harnessing for both reach to a specific control or a reach envelope (McDaniel, J.W., 1990). (Task 718408)

The above research and development work in physical anthropometry by personnel of the division's Physical Ergonomics Laboratory is only a small sample of the work done there in taking measurements of human physical dimensions, reach capability, strength and endurance, reaction time, time to perform tasks, etc. The laboratory has massive databases built on hundreds of thousands of measurements. These databases are often adequate for answering designers' questions. The Computer-Aided Workplace Design Facility of the laboratory is a network of computer work stations for developing and using expert ergonomics models, such as COMBIMAN, CREW CHIEF, and Virtual COMBIMAN, for visualizing physical performance in the workplace. When database entries and use of the computer models are inadequate for finding satisfactory answers for design questions, the rapid prototyping facilities of the laboratory allow it to quickly perform high-fidelity studies on task executions in work situations.

In the above discussion of physical anthropometry in the Human Engineering Division, it was noted that some of the technology of physical anthropometry, such as computer models, began in an earlier decade, and that development of the technology is still progressing. Figure 1-15 illustrates the chronology of important events, landmarks, and accomplishments in workplace technology resulting from the last 50 years of research and development work performed by the Human Engineering Division.

Engineering Anthropometry

The last decade has witnessed major technological leaps in the field of engineering anthropometry, and the Human Engineering Division has been at the forefront. The biggest innovations were in the areas of database systems, advanced statistical methods and applications, and 3-D anthropometric data collection.

Previously, the hundreds of anthropometric data collections were stored on shelves of magnetic tapes. During this decade, these were transformed into collated, searchable files on-line, and were made available off-site through modems. They were also integrated with statistical analysis tools that would enable the data system to actually write some of the analysis code. This work is still evolving with the development of object-oriented database software that will allow data to be stored and searched as objects, rather than individual elements, and with the rapidly changing Internet environments that are making information available to a much wider audience in forms easier to understand, visualize, and manipulate. This holds incredible promise for the next decade.

Analytic methods for anthropometric multivariate data representation, which were previously available only to the advanced statistician, were taken into the cockpit. Since the 1960s, gross errors, which resulted from the use of percentiles, had been demonstrated but remained in common use due to the complexity of alternative approaches. Figure 1-16 illustrates one of the problems with the

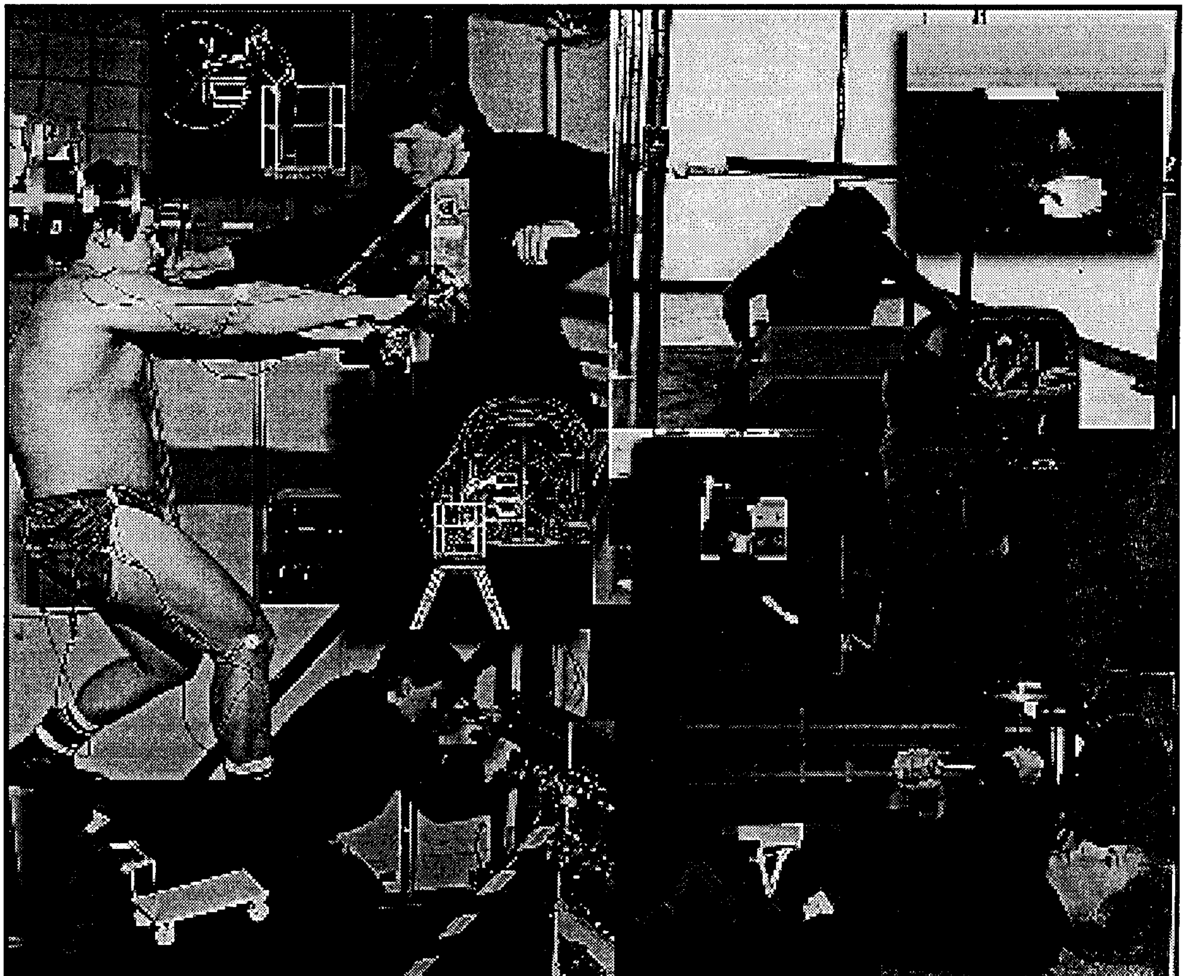
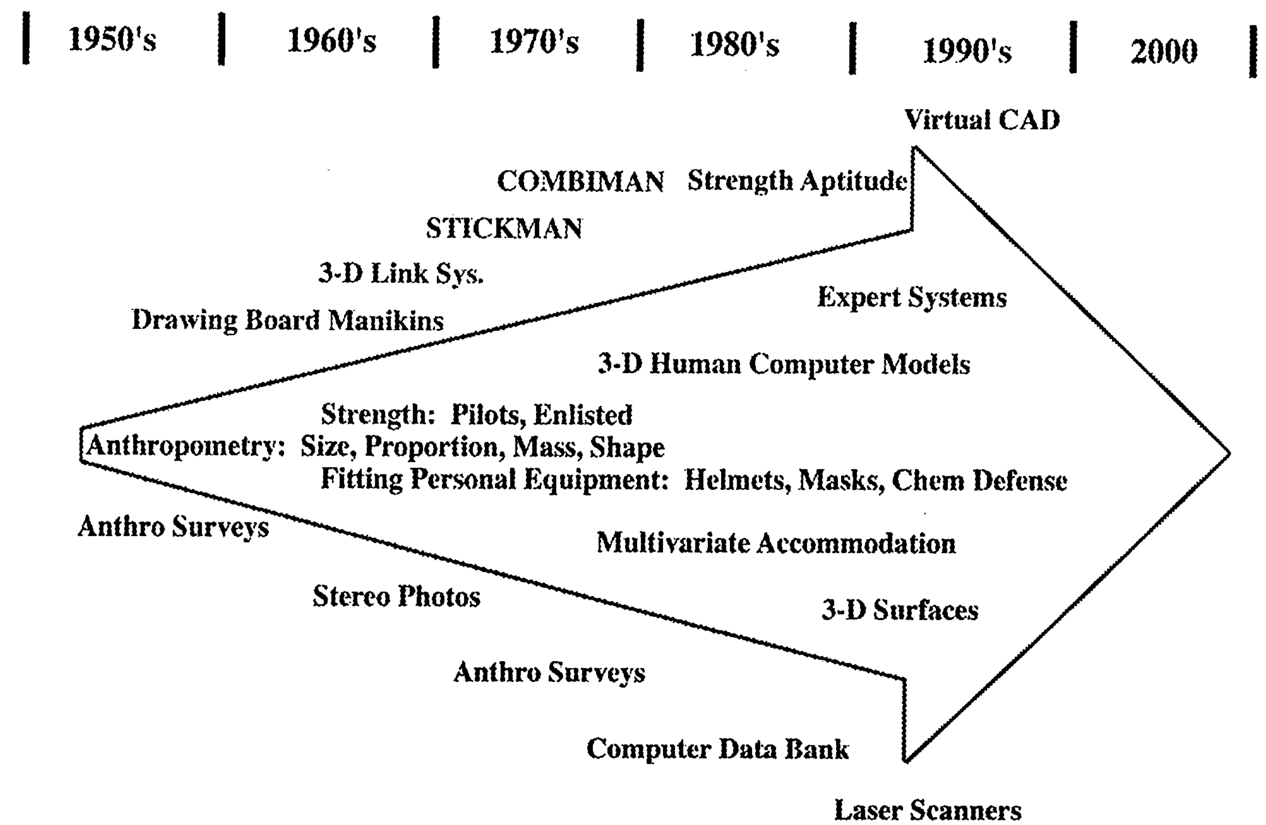


FIGURE 1-14: CREW CHIEF

CREW CHIEF, derived from COMBIMAN, automatically simulates maintenance activities, both with hand tools and materials handling (lifting, pushing, carrying, etc.), to determine if a maintenance activity is physically possible. Expert system software creates the 3-D human model with a full range of body sizes for men and women, the encumbrance of 4 types of clothing, 12 different maintenance postures, and a 222-piece tool kit. It automatically analyzes physical access for reaching into confined areas (with hands, tools, and objects), visual access, and strength. Visibility and task interference analyses can be computed with this "electronic mock-up" (Annis, J.F., McDaniel, J.W., & Krauskopf, P., 1991). (Task 718408)

use of percentiles and the magnitude of the impact from their use. As each new variable is designed or limited to just the 5th to 95th percentile, more and more people fall outside the accommodation range. The people who are extremely large or small for one variable are not the same people who are extremely large or small for another. Therefore, the more percentiles you use, the fewer people you accommodate. The purpose for using percentiles was to accommodate a particular percentage of a population. For example, the 5th and 95th percentiles were used with the intent of accommodating 90 percent of the population. This figure demonstrates that this is clearly not the case.

Greg Zehner, in 1992, demonstrated a practical implementation of an alternative multivariate approach, using principal component "cases" to evaluate cockpit accommodation. One of the first applications was in the acquisition of the T-1 aircraft. This acquisition was to be an "off-the-shelf" purchase, and manufacturers supplied their candidates for evaluation. After the multivariate anthropometric evaluation, it was determined that the otherwise best candidate would not accommodate 30 percent of white males, 80 percent of black males, and 90 percent of females who would qualify for flight training in the configuration presented. The cause was determined to be a problem with the



50 Years of Workplace Accommodation Technology

1946 - Strength for Aircraft Controls first measured in Paul Fitts division
1950 - Body size survey of 4,000 male pilots, 146 dimensions
1950 - 2-D Drawing Board Manikins depict range of body sizes for designers
1955 - 3-D Link System developed, relations between external flesh and internal joint centers defined
1957 - Masses of body segments for acceleration and crash test research
1958 - Stereo photography used in 3-D body size measurements
1959 - First general sizing system for flight clothing
1965 - Body size survey of 1,905 Air Force women, 139 dimensions
1967 - Body size survey of 2,420 male flight crew, 189 dimensions
1972 - STICKMAN is first human mel (stick figure) applied to first-generation computer-graphics displays
1974 - Strengths for aircraft control measured on centrifuge during high acceleration
1975 - COMBIMAN development began, 3-D computer model of aircraft pilot
1978 - COMBIMAN first transferred to aerospace industries
1978 - Female strength for operating aircraft controls first measured
1980 - Anthropometric relations with body segment masses and moments of inertia
1984 - CREW CHIEF model of maintenance technician began; interfaced to industry CAD systems
1987 - Strength Aptitude Test for all enlisted recruits approved by Secretary of Air Force
1988 - 3-D coordinates of head surface with laser scanner
1988 - CREW CHIEF first transferred to industry, began widespread use to evaluate maintainability
1988 - CARD dial-up body size database: Computerized Anthropometric Research Data
1994 - Virtual COMBIMAN Phase 1 puts viewer inside 3-D cockpit drawing during landing; variable sitting height
1995 - Multivariate accommodation technique used to evaluate JPATS trainer aircraft prototypes
1995 - Comprehensive male/female strength for all types of aircraft controls

FIGURE 1-15: WORKPLACE ACCOMMODATION

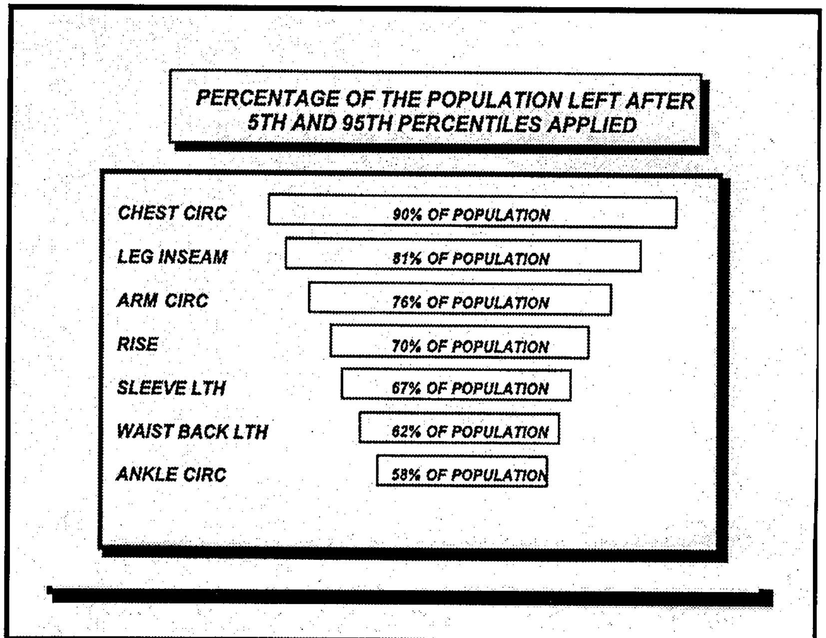


FIGURE 1-16 PERCENTILE VALUES
An illustration of the reduction in accommodation with each additional application of percentile values. (Task 718408)

yoke throw. This is pictured in Figure 1-17. This problem is manifested in those people who have short torsos and long legs or short torsos and large thighs. These represent combinations of small and large measurements which could not be characterized with percentiles and, thus, would not have been detected if only percentiles were used. In fact, we were told that the aircraft was designed for the 1st to 99th percentile pilot, and the manufacturer fully expected to accommodate at least 98 percent of the white male population. Since black males tend to have shorter torsos and longer legs than white males, and females tend to have shorter torsos and larger thighs than males, these groups were most affected.

That story ended well. Having identified the cause, the multivariate method also helped to identify the solution. The manufacturer was able to reconfigure the yoke to accommodate 99 percent of all of the eligible pilot populations.

Once the success of the multivariate approach for eligible pilots was demonstrated, the next question became, "who should be eligible pilots?" With Congressionally mandated policy changes on women in combat, the multivariate accommodation method began to be employed to evaluate accommodation beyond the former entry limit standard of 64-78 inches in stature and 34-39 inches in sitting height. This impacted the requirements for the Joint Primary Aircrew Training System (JPATS) Program, and anthropometric accommodation became one of the two highest selection criteria for that aircraft. Anthropometry, a term few people knew in the last decade, was for the first time being debated by Congressional staffers.

These developments were new and exciting, but perhaps the greatest change from the previous decade was the development and use of new automated 3-D surface scanning technologies for anthropometry. Some three-dimensional anthropometric data, collected prior to the mid-1980s, can be classified as two types: 1) measurement of a finite set of “homologous” points either statically or during motion, and 2) measurement of detailed points on static bodies. The former type of measurement requires a clear definition of all homologous points to be measured, referred to as landmarks, prior to measurement. On static objects, these points were measured mechanically by moving a stylus to each of the pre-defined (and often pre-marked) points and recording the stylus position. For example, Snyder, in 1972, used moveable scales and plumb bobs to record points on cadavers. Reynolds and Leung, 1983, implanted targets in unembalmed cadavers which were then captured with x-rays in stereo pairs. Gordon et al., 1988, used a mechanical stylus with a computerized 3-D locator for head measurement of living US Army personnel. A head box with a special clamp was used to steady the head as the stylus was moved from point to point.

Detailed 3-D measurement was limited to methods which did not automatically translate to geometric information, but rather the geometry had to be somehow manually extracted. One such method is stereo-

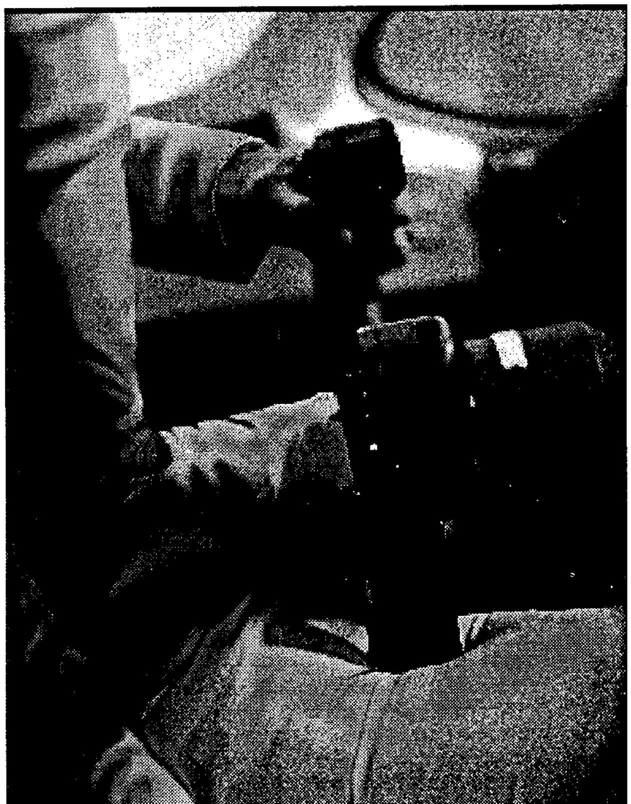


FIGURE 1-17: YOKE INTERFERENCE
Photograph of a pilot with yoke interference in the prototype T-1 aircraft. (Task 718408)

photography. Stereophotogrammetry basically captures the exterior surface with linked pairs of photographs. While it captured the images rapidly, the manual digitizing of the images was extremely slow. As a result, the number of subjects digitized in any one study was small; one set of studies which used stereophotogrammetry for estimating mass distribution properties of body segments measured just 31 men and 46 women.

New automated digital scanning technologies began appearing in the 1980s. The first one to be put to practical use was a head and face scanner produced by a company called Cyberware. Cyberware had developed a scanner for making realistic busts, much as portrait photographs are taken. It wasn't until they were approached by the anthropometry group at the Human Engineering Division that they considered it as a potential measurement tool. The anthropometry group worked with Cyberware to modify it for this purpose, adding a calibration tool and supporting software, for example. By 1987, the first head and face 3-D survey was completed at Wright-Patterson Air Force Base by the anthropometry group. In 1988, the scanner was taken on the road to three Air Force bases. This system is now the system against which others are compared. A photograph of the scanner is shown in Figure 1-18.

Automated 3-D scanning surmounts several problems inherent with the use of traditional anthropometry. For example, a nearly infinite number of contours can be derived from the traditional measurements; therefore, items produced by different manufacturers meeting the same anthropometry specifications can produce very different products in terms of shape and, ultimately, fit. In other words, due to anthropometry limitations, most of the surface of human models in the past has been filled in by artistic interpretation. This is true for ergonomic models such as COMBIMAN, CREW CHIEF, MANNEQUIN, SAMMIE, and JACK; biodynamic models such as ADAM and VIP; clothing body forms; oxygen masks; face forms and head forms for helmets. Furthermore, recent helmet fit testing has revealed that human surface geometry data

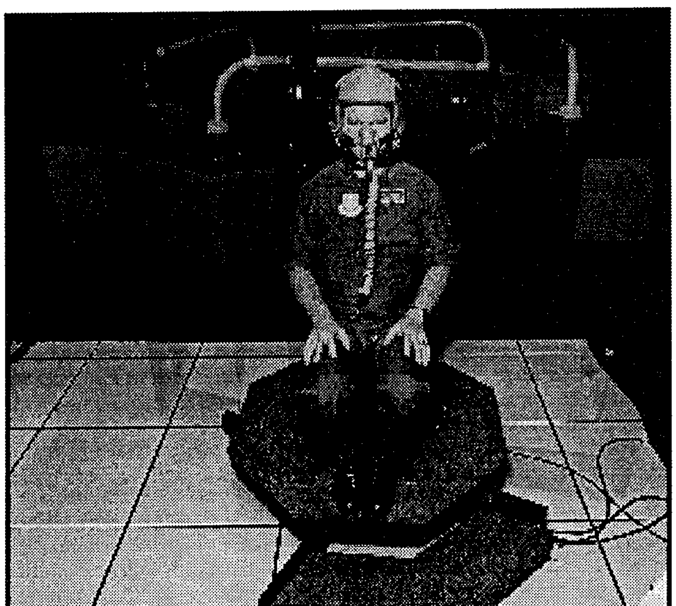


FIGURE 1-18: 3-D SCANNER
The automated 3-D scanner used in the first anthropometric scanning survey. Developed under a program managed by Kathleen Robinette, it was responsible for changing the field of anthropometry worldwide. (Workunit 71840850)

and the 3-D geometric link to the equipment are essential for understanding the underlying cause for fit problems and for quantifying and correcting them. As a result, knowledge of contour geometry can be critical to the success or failure of an equipment system. With the new automated 3-D scanning technology, it is possible to quantify the person and the equipment in 3-D space for the first time.

This new technology also makes it possible to exploit the power of new rapid prototyping and custom manufacturing technologies. For example, in 1995, a program was initiated to develop an automated method for producing custom-fit, positive-pressure oxygen masks. The ability to make prototypes quickly will reduce development costs by eliminating risk factors early in the design process. The ability to custom fit equipment will maximize accommodation levels, allowing accommodation of virtually 100 percent of a population. It can also reduce inventories and the cost of developing sizes for small percentages of the population. If effective, it can save billions of dollars.

The advantages of 3-D scanning are clear, and, in 1995, the Human Engineering Division acquired the first practical full-body 3-D scanning system and is planning the first international 3-D full-body survey. This will be a modern technology version of the NATO survey conducted by Mr. Hertzberg and associates in 1960-61. In the next decade it can be expected that this information, software tools, and application methods will be available on the information superhighway.

Crew-Centered Cockpit Design

Until the early 1980s, the laboratory did not have advanced development projects with which to demonstrate and mature its basic research and exploratory development products. The previous decade witnessed the emergence of high-technology sensors, weapons, and aircraft, which posed serious cockpit workload and safety concerns. The era also commenced a trend toward fewer crew members to lower acquisition cost, but that further aggravated the workload and safety concerns. Some systems emerging from flight test evidenced considerable cockpit-related design problems, requiring costly rework late in development. Senior Air Force leaders recognized that the Air Force lacked an advanced development project to focus the needed technology for the future (Figure 1-19).

In March 1980, the Air Force Systems Command directed the Air Force Laboratories to plan a new advanced development project for cockpit design technology. In response, a multi-laboratory working group (under a steering group comprising all AFSC Laboratory Commanders) planned the new project up to the point of a command decision to proceed. During the planning phase, the Air Force Studies Board (AFSB) convened a summer study at Woods Hole, MA in 1981 on "Automation in Combat Aircraft." The AFSB was an advisory group to the Commander of the Air Force Systems Command and comprised nationally renowned experts who made recommendations on topical issues. The 1981 summer study concluded that the Air Force should establish an advanced technology project to better organize how crew systems should be developed. The Studies Board met again in February, 1982, at Wright-Patterson Air Force Base, reaffirmed the summer study conclusions, recognized that the Air Force lacked an advanced technology project to focus this technology, and the AFSC Commander directed that the project be funded. Originally named Cockpit Automation Technology, the work was assigned to the Armstrong Laboratory and Human Engineering Division in 1982. The project was later renamed Crew-Centered Cockpit Design (CCCD).

The CCCD Project seeks to advance the state-of-the-art in crew system design technology, both for the process of design and for the tools that support the design process. The main products of the CCCD development are its highly disciplined process for cockpit design and a complete set of support tools and technology that will help to make the process efficient. Spanning all phases of system acquisition from concept exploration through production and deployment, the CCCD process is implemented on a computer design system having an integrated set of computer tools for crew system analysis, design, and test. Crew-centered cockpit design represents a new

capability for human systems integration, one that is compatible with and improves upon the current design practice. By designing the cockpit with the crew capabilities as the central focus, CCCD can maximize the air crew's ability to meet the challenge in future air operations.

In its first decade, the CCCD project directly influenced the way that crew systems are designed and acquired, in the aircraft industry and in DOD's acquisition and test agencies. Five of the nation's aircraft manufacturers participated in CCCD research and development contracts and continue to organize their crew system projects from a crew-centered focus. For example, Boeing replicated a version of CCCD's computer design system for use on its military aircraft projects, and McDonnell Douglas continues to maintain its own Advanced Crew-Centered Technology Project. Both are evidence of technology transition. The CCCD project published the first-ever industry survey of the cockpit design process and tools. The CCCD project participated in the F-22 development through a Memorandum of Agreement, contributed to its cockpit specification, was part of the System Program Office (SPO) Cockpit Working Group, and CCCD's crew-centered mission scenarios were the models for the design missions used in the F-22 demonstration/validation phase. The CCCD project advanced the recommendation to raise the reporting level of Crew System Development in the Work Breakdown Structure. The F-22 SPO, departing from tradition, adopted the idea and elevated its crew system team for better management visibility and influence. CCCD's published work on the organization of the design process both in industry and government was the model for the design process and detailed Crew System Engineering Master Schedule, both codified in MIL-STD-1776A, thereby affecting all future Air Force cockpit acquisitions. A particularly successful part of the CCCD project is its Test Planning, Analysis, and Evaluation System (Test PAES), now completing operational tests at more than 20 flight test agencies, including all of the USAF Combined Test Forces, Army and Navy test centers, and non-DOD customers, supplying an entirely new test and evaluation support capability for planning and performing cockpit evaluation.

3. Innovative Human System Interfaces

Visually-coupled, helmet-mounted technologies allow aircrews to operate in day or night environments, providing essential flight attitude and targeting information which permits off-bore sighting of weapons and sensors. Improvements in image intensifier technology will allow for the demonstration of Night Vision Goggles (NVGs) with a 60-degree field-of-view in 1995. While NVGs serve a

FIGURE 1-19: THE CREW-CENTERED RECONFIGURABLE COCKPIT
Control, monitor and record real-time part-task, full-mission simulation. (Project 2829)

wide range of aircrew applications, the helmet-mounted display (HMD) that provides head-up display (HUD) symbology, forward-looking infrared (FLIR) and low-light level TV (LLLTV) imagery, or simple targeting cues, has a place in the high-performance cockpit as well as special operations aircraft. Critical technologies in the areas of three-dimensional audio localization, miniature video displays, and head trackers essential to an integrated helmet-mounted system were under development during this period.

Night Vision Operations and Aircraft Transparencies

The Human Engineering Division had its first exposure to night vision goggles in 1977, when it was loaned a pair of PVS-5 NVGs by then Major Robert Verona of the US Army for evaluation in possible Air Force applications. Two years later, in 1979, Human Engineering Division scientists, Dr. Lee Task and Leonard Griffin, were fully prepared to respond to the Military Airlift Command's request for assistance in modifying their HH-53H Pave Low III helicopter interior lighting to be NVG-compatible for the first time ever, thanks to the experience gained with the loaned PVS-5 NVGs.

This was the beginning of an expanding series of night vision operations projects, in direct support of a multitude of Air Force and Army NVG users, that came to full fruition during the 1985-1995 decade. Night Vision Operations activities have resulted in nine US Patents, with six other NVG-related inventions in patent-pending status. Under the expertise, innovativeness, and technical guidance of Dr. Task, there were numerous significant accomplishments during this time frame involving several key personnel. These include the developing, testing, and fielding of an NVG-compatible covert landing aid for landing cargo aircraft in austerely lit, potentially hostile environments (1982, Leonard Griffin); an NVG symbology overlay display, NVG-HUD, allowing the pilot to maintain an "eyes out" orientation during flight thereby decreasing workload and increasing mission safety and effectiveness (1982-1983, Leonard Griffin and Jeff Craig); low-profile NVGs offering a better center of gravity for paratroopers and possible aircraft ejection capability (1986, Jeff Craig); portable covert runway/taxiway marker lights for use with NVGs in both fixed and rotary wing aircraft (1987, Jeff Craig); NVG resolution charts for pre-flight optimization of NVG focusing (used in Operation Desert Storm-1990, Mary Donohue-Perry); NVG measurement methodology for assessing and validating NVG performance (1990-1995, Pete Marasco and 1st Lt Rich Hartman), a night vision ambient illumination tester for use in the laboratory or field to assess the degree of illumination present in a proposed NVG operating environment (1994, Dr. Alan Pinkus); and wide field-of-view NVGs offering a tremendous increase in the intensified night viewing area (1995, Jeff Craig) (Figure 1-20). Numerous other NVG-related human performance studies, aircraft lighting modifications, and technical consultations positioned the Human Engineering Division as one of the major forces in successfully transitioning night vision technology into Air Force operations.

During the early 1970s, the F-111 aircraft converted from thin glass windscreens to thicker plastic windscreens to improve birdstrike resistance. With this conversion came numerous new visual characteristics (Figure 1-21) of the thicker plastic windscreens, causing potential visual problems for the aircrew. Optical/visual windscreen analysis started at Brooks AFB, Texas, but, by the mid-1970s, transitioned to the Human Engineering Division. Initial activity centered around the visual problems identified with the F-111 conversion, which included multiple imaging, distortion, and haze. Multiple imaging was particularly disturbing during night landings in that the pilot would see two sets of runway marker lights due to the multiple reflections within the new plastic windscreens. Means of characterizing this effect and others are among the major accomplishments of the Human Engineering Division windscreen group during this time period (key personnel included Dr. Robert Eggleston, Lt Col Lou Genco, Dr. Lee Task, Bill Kama, Capt Mike

FIGURE 1-20: ADVANCED LOW-PROFILE NIGHT VISION GOGGLE (NVG)
Combining unique folded optics with high-resolution image intensifiers has resulted in a high-performance, ejection style NVG with a wide 45-degree field-of-view. (Task 718418)

Tutin, John Bridenbaugh, Harold Merkel, Dr. Alan Pinkus, and Pete Marasco). Standardized test methods for multiple imaging, distortion, haze, angular deviation, binocular disparity, reflection, and transmission were developed and published through the American Society for Testing and Materials (ASTM) for easy availability to both military and civilian applications. A total of twelve US patents, three other inventions still pending, and numerous human performance studies, presentations, publications, and consultations to both military and civilian organizations characterized this highly productive, successful program.

Visually-Coupled and Visual Display Systems

In this technology area, design criteria, component technology, and systems for visually-coupled helmet systems (VCHS) are developed on the basis of psychophysical theory and human performance data obtained in laboratory studies and on functional assessments during field evaluations under operational conditions. The state-of-the-art for VCHS was advanced by improved optical system and electronic circuit designs, hardware, and associated software. These improvements impact the performance and applicability of helmet display systems both militarily and commercially and allow research into the man-machine interface (MMI) to be pursued further than previously possible. Virtual display system component technology developments have been pursued under the Virtual Panoramic Display (VPD) program for transition to industry and the Armstrong Laboratory's Helmet-Mounted Sensory Technologies (HMST) 6.3A Advanced Development Program.

The Visual Display Systems Branch of the Human Engineering Division of the Armstrong Laboratory has played the key role in the development of helmet-mounted displays and sights and of visually-coupled systems. This technology is now used in many aircraft weapon systems and, increasingly, in other applications, both military and civilian. The division involvement dates from the mid-60s when Dr. Thomas Furness, Dean Kocian, James Brindle, and Charles Bates, of what is now the Visual Display Systems Branch, foreseeing the potential of the technology for improving the performance of military aircraft, initiated a program lasting decades to extensively develop it (See Table 1-3).

Over the past decade, the lab has focused on critical system and component tests and human factors experiments to solve the problems of integrating helmet-mounted display systems with the human visual system and advanced weapons systems. As evidenced by the many premier accomplishments shown in Table 1-3, the lab's research results have been successfully employed to optimize helmet-mounted display and miniature CRT phosphors, gun designs, and cathodes by investigating binocular vision, resolution, and contrast perception.

Dr. Brian Tsou led both equipment engineering research and human factors efforts involving the relationships between binocular helmet display design and visual performance of the human operator. In particular, he conducted research on binocular

TABLE 1-3 - Integrated Visually-Coupled Systems (VCS)/Night Vision History (29 Years of Armstrong Laboratory (AL) Leadership)*

YEAR	EVENT
1966	- First Remote HMS Development Inaugurated to Slew Sensors on B-50 Test Aircraft (Code Name: JB50).
1967	- Miniature CRT and HMD Development Initiated.
1968	- JB50 HMS System Accepted and Made Operational.
1969	- JB50 System Installed and Successfully Tested in Navy F-4B at Point Mugu NAS for Radar and Weapon Seeker Slaving Using Head LOS. - HMT and HMD Combined to Form First VCS (Precursor to All Subsequent Virtual Reality Systems). - HMS Pointing and Tracking Accuracy Study Initiated by AL at Tyndall AFB, FL F-101 and F106B aircraft.
1970	- First Direct Interface of HMS with Infrared Seeker Missile (AIM-4D) in F-106B with Live Fire Drone Shots and Kills Using Head-Slaved Seeker. - First Take-Offs and Landings Using Windowless Cockpit and HMD-External Camera Only Performed in F-100 at Kelly AFB, TX.
1971	- Visor Reticle Display for HMS Successfully Demonstrated by AL. - Advanced HMT Technology Development Begun by AL Involving Ultrasonic, Infrared, and AC Magnetic Technologies. - VCS Interface Successfully Demonstrated with Maverick Electro-Optical Seeker Head Prototype. - First VCS LOS Steering of Aircraft Using Head Motion Demonstrated by AL Personnel in C-131 Aircraft. - Tyndall AFB HMS Accuracy Tests Successfully Completed Resulting in Special Report ADC 69-19.
1972	- Visor Reticle Display and Infrared Tracker Technology Successfully Transitioned to Navy for Use in F-4 Retrofit Program. - Aiming of Aircraft Weapons Using HMS Demonstrated in C-130 Gunship. - Advanced HMT Technology Program Completed with AC Magnetic Approach the Clear Winner. - Program 5973 (Advanced Technology Demonstration) for Airborne-Qualified VCS Initiated. (Would later be Transferred to Aeronautical Systems Center in 1975) - First-Ever VCS Symposium Organized by AL and Held at Brooks AFB, TX. Papers Covered Head-Mounted Technology That Would Eventually Find Its Way Into Operational Use, as well as Virtual Reality Systems, Beginning in the Mid-1980s.
1973	- First Successful Visor-Projected Imagery Display Demonstrated for HMD Application. - First Successful Remote Oculometer System Demonstrated by AL Personnel. - Big Picture Concept Formulated. Essentially, the Concept was to Place Most of the HUD Information on the HMT/D System, Allowing the HUD to be Down-Sized, and Permitting Room in the Cockpit for Large Area Displays that Interacted with the HMT/D and Could More Effectively Present Global "Strategic" Information While the HMT/D Provided the Pilot with Near-in "Tactical" Information. - VCS Concepts Demonstrated With Long-Range Electro-Optical Seekers in Pave Scope at Edwards AFB, CA.
1974	- First-Ever Head-Steered Laser Designation Demonstrated in Pave Spike Program Using F-4 at Eglin AFB, FL.

YEAR	EVENT
1975	- Visually-Coupled Airborne Systems Simulator (VCASS) Program Initiated. Concept Involved the Design and Fabrication of a High-Resolution, Wide Field-of-View (FOV) HMD with High Resolution, Six Degree-of-Freedom HMT to Provide Scene Simulation with VCS Interactive Graphics Interface Overlay. Precursor to Modern Virtual Reality Systems.
1976	- Infrared HMT, Model 3 HMD Optics and Miniature CRT Technology Successfully Transitioned to Army Apache Program. - Advanced Miniature CRTs Developed for Use with HMDs.
1979	- Wide FOV (100°-140°) Partially Overlapped HMD with Successful Distortion Correction Demonstrated by AL Personnel. - First-Ever Demonstration of NVG with Compatible Cockpit Lighting Demonstrated in HH-53H Helicopter.
1980	- AL Personnel Complete Landmark Study Involving Incandescent Versus Electro-luminescent Lighting for Austere/Covert Runway Lighting to Support Covert Flight Operations.
1982	- NVG-Compatible Lighting Installed in A-10, AC-130H, and MC-130E by AL Personnel. - First-Ever NVG/HUD Designed and Built by AL Personnel and Installed on C-141B. - First-Ever Infrared Approach Path Indicator Developed for NVG Landings. - Full-Up VCASS Virtual Reality System Completed and Demonstrated.
1983	- AL Personnel Install NVG-Compatible Cockpit Lighting into CH-3, HH-53B/C, C-103E, and HC-103P. - NVG/HUD Installed and Flight Tested by AL Personnel on C-130E, MC-130E, and AC-130E Aircraft. - Day/Night Aerial Refueling Patent Employing NVGs Issued to AL.
1984	- NVG/HUD Installed and Tested on UH-60A, HC-103P, HH-53H, and HH-53B/C. - Virtual Panoramic Display (VPD) Program Begun in Support of Army LHX Helicopter Program. Essentially This Program Would Develop, Build, and Demonstrate Advanced VCS Technology to Support the LHX Night Pilotage FLIR. - Advanced Subminiature CRT Program Initiated for NVG/HUD and HMD Application.
1985	- First-Ever Diffuse Incandescent Runway Marker Light for Overt/Covert Operations and Glide Slope Indicator Demonstrated and Receives Separate Patents. - Advanced Subminiature CRTs Demonstrated for Use in NVG. Become DeFacto Standard for Narrow FOV HMT/Ds.
1986	- First Low-Profile NVGs Developed and Demonstrated by AL. - First DC Magnetic HMT Developed and Demonstrated in F-16 Attached to Green Mountain Air National Guard in Vermont.
1987	- NVG and NVG-Compatible Lighting Developed and Installed in B-52. - Advance "Box-and-One" Covert Landing Developed and Demonstrated by AL.
1988	- Unique "Contrast Sensitivity Function Measurement Chart" and Method Developed, Demonstrated, and Patented by AL. - AL Develops First-Ever "Deceleration, Prefocus Lens" Miniature CRT Able to Maintain Nearly Constant Line Width Over Large Beam Current Changes. - VPD HMD Prototypes Demonstrated to US Army Personnel. - Vista Sabre I Simulation Study Completed and Demonstrated Advantage of HMT/D Used in Conjunction with High Off-Boresight Angle (HOBA) Missile Seeker in Fighter Aircraft.
1989	- First Ultra High-Resolution Sputtered Phosphor Screen Developed and Tested in Miniature CRT. - Army Downselects VPD HMD Prototypes, for Which it Wants Flyable Brassboard Versions Built.

YEAR	EVENT
1990	- NVG-HUD Installed and Tested in MH-60J. - NVG Resolution Chart Perfected and Fielded On Short Notice for "Desert Storm" Operation.
1991	- Unique Robust Minimum Variance Linear Estimator (MVLE) Developed and Demonstrated for AC Magnetic HMT. - Unique Personal Illumination Marker Built and Demonstrated. - Vista Sabre II Program Initiated to Install HMT/D Systems in Two F-15Cs Located at Nellis AFB, NV.
1992	- NVG-Compatible Lighting Designed, Installed, and Flight Tested in B-1 Bomber. - First-Ever Course Prepared and Presented at SPIE International Symposium. - Miniature CRT Aviation Connector (AVCON) Demonstrated, Which Greatly Enhanced HMT/D Performance and Supportability by Fighter Squadron Personal Equipment Personnel.
1993	- Agile Eye™ Plus HMT/D Systems Successfully Integrated and Flown in Vista Sabre II. - AL Personnel Help Navy Initiate Their Own Vista Sabre Program Using F-18 and F-14. - NVG Low-Profile (Concept VI) System Demonstrated. - Unique Ambient Illumination Tester for NVG Developed by AL Personnel. - Programmable Airdrop Infrared Decoy Developed and Patented. - World's First Successful Mechanical High-Voltage, Quick-Disconnect Connector (QDC) for HMD Developed and Tested. - First "Standardized" Helmet-Vehicle Interface (HVI) Conceptualized. - World's First Miniature Subtractive-Color LCD Image Source Demonstrated.
1994	- Field Evaluation of NVG-Compatible Lighting Designs Evaluated for C-17, F-22, F-16, and C-130H3. - Wide FOV (Up to 60°) NVG (NOVA-8) Demonstrated. - Liquid Crystal-Based NVG/HUD Developed. - Agile Eye™ Mark III HMT/D System Flown in F-15C at Nellis AFB with Joint USN/USAF Developed HOBS Captive Carry Missile Seeker. - AL VPD System Delivered to Army and Used to Demonstrate Army's New High-Resolution LLLTV System at NVESD. - Visually-Coupled Acquisition and Targeting System (VCATS) Program Initiated to Develop Advanced HMCS for F-15C/D/E Aircraft.
1995	- Monochrome Field-Emitter-Array (FEA) Cathode Miniature Flat CRT Demonstrated. - Landmark Chapter on VCS Technology Written by AL Personnel and Entitled "Visually-Coupled Systems Hardware and the Human Interface," Published in Oxford University Press Book, *Virtual Environments and Advanced Interface Design*.

***NOTE:** Acronyms Used In Chart Are Explained Below.

VCS: Visually-Coupled System
NVG: Night Vision Goggles
HMT: Helmet-Mounted Tracker (head orientation and/or position)
HMS: Helmet-Mounted Sight (HMT plus fixed sighting display)
HMD: Helmet-Mounted Display (display only - doesn't include HMT)
HMT/D: HMT plus HMD
NVG/HUD: NVG plus head-up display overlay viewed through NVG.
CRT: Cathode Ray Tube
HMCS: Helmet-Mounted Cueing System
LOS: Line-of-sight from head azimuth and elevation orientation.
HOBS: High Off-Boresight Seeker
HOBA: High Off-Boresight Angle

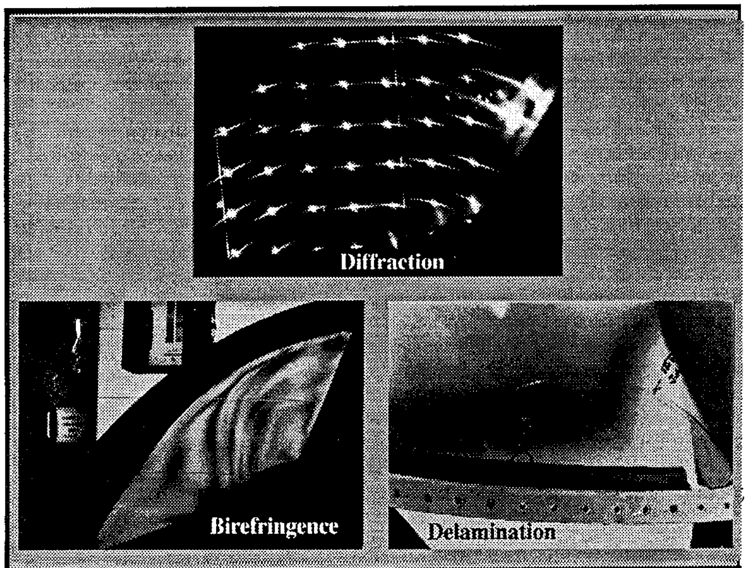


FIGURE 1-21: OPTICAL EFFECTS OF AIRCRAFT WINDSCREENS
Examples of some optical effects encountered in F-111 and B-1 aircraft windscreens. (Task 718418)

contrast sensitivity while using virtual image displays and generated binocular field-of-view requirements for the designing, building, and testing of next-generation, helmet-mounted displays. Two published studies have shown that the effective binocular visual field is about 40 degrees wide, and not the generally accepted number of 120 degrees, and that a divergent optics setup for overlapped binocular displays is superior to a convergent setup. Designers of Comanche helicopters have redirected their helmet-mounted display efforts to take advantage of these binocular vision research results.

The Visually Coupled Airborne Systems Simulator (VCASS) project directed by Dean Kocian began in 1977, as an effort to develop a fixed-base virtual environment simulator in which to investigate advanced airborne visually coupled concepts and their associated technologies. What set the Visually Coupled Airborne Systems Simulator apart from other fixed-base simulators was that all visual events within the simulation took place on a large field-of-view, partially overlapped binocular helmet-mounted display (HMD) that could generate 3-D stereo images and required special distortion correction to linearize the image viewed on the display. A six degree-of-freedom magnetic head tracker drove the scene presentation and allowed the parallax, due to head movements with respect to objects close to the observer, to be properly displayed. These advanced systems, when coupled with the wide field-of-view display system, resulted in a simulator that immerses the observer within an easily reconfigurable, computer-generated world, displayed relative to the observer's head movement (Figure 1-22). Since its initial demonstration, it has served as a bed for investigating visually coupled display perceptual issues and the applied evaluation of candidate helmet-mounted display symbologies designed for specific tactical arenas. During the mid-1980s, Michael Haas successfully employed VCASS to demonstrate advanced rotocraft displays and interfaces for the Army LHX Helicopter Program. Later, Dr. Robert Osgood systematically employed VCASS in the research, design, and evaluation of off-boresight helmet-mounted symbologies with the goal of enhancing pilot performance by providing information about critical flight status, weapons systems, and warnings, regardless of head orientation or movement.

Color display design criteria development was led by Dr. David Post, through work performed at the Color Display Laboratory (CDL). The increasing performance and diversity, and decreasing cost, of electronic color display technology create new demands and opportunities for exploiting color's advantages for conveying information. Effective use of color requires knowledge of display capabilities and human needs. The primary emphasis of the CDL has been on the production of devices, software, data, and mathematical models relevant to the design, evaluation, measurement, and use of color displays throughout the Air Force. These efforts have produced a high-resolution and high-brightness prototype Miniature Color Display based on stacking three monochrome liquid-crystal displays together and operating them in a subtractive-color mode. The resulting Miniature Color Display provides

daytime visibility with no resolution loss. Other products have included a high-efficiency, triband metal-halide lamp, a light-recycling pre-polarizer, and notch filter polarizers, all of which contribute significantly to the brightness of subtractive-color displays.

In 1993, the Vista Sabre II HMD Tech Demo Program retrofited two F-15Cs of the 57th Test Group at Nellis AFB with helmet-mounted display and head-tracker systems for the evaluation of high off-boresight weapon system use in an operational environment. Managed initially by Maj Vince Parisi and Dean Kocian and later by Randy Brown and Dean Kocian, Vista Sabre II began as a Congressionally mandated special project to evaluate and demonstrate the effective use of helmet-mounted cueing systems and symbology in "fast jet" combat aircraft. Inputs from the combat pilots at Nellis allowed the Visually-Coupled Acquisition and Tracking System (VCATS) Program to be inaugurated in 1994 as a top-ten ranked Advanced Technology Demonstration Program for Air Combat Command. VCATS will demonstrate advanced helmet-mounted tracker, image source, helmet technology, and perhaps most importantly, concepts for a "standardized" helmet-vehicle interface (HVI) that will promote commonality between USAF and USN fighter aircraft platforms.

Virtual Reality/Super Cockpit

One of the most challenging new technologies for application in the crew station is use of synthetic environments (SE), or what civilians call virtual reality. Capitalizing on two decades of helmet-mounted display work, SE has risen to the forefront in night operations which have been employed in Panama and Desert Storm. The simplest forms are the night vision goggles worn by aircrews. These will be supplanted by head-steered forward-looking infrared (FLIR) and later by multi-sensor systems that automatically switch or correlate their information. Hearing and touch will be brought into play with three-dimensional sound and tactile feedback. Controls will include helmet-mounted sights, such as in the Apache helicopter, and later, virtual switches actuated by tracking hand and finger motion through instrumented gloves. SE will provide "natural" user interfaces and the ultimate capability of tailoring the cockpit in both displays and controls to mission demands and user capabilities. Evolution of virtual reality, or synthetic environments technology, has been accelerated by the Human Engineering Division's coordinated development of component technologies and the human engineering integration required of the overall system.

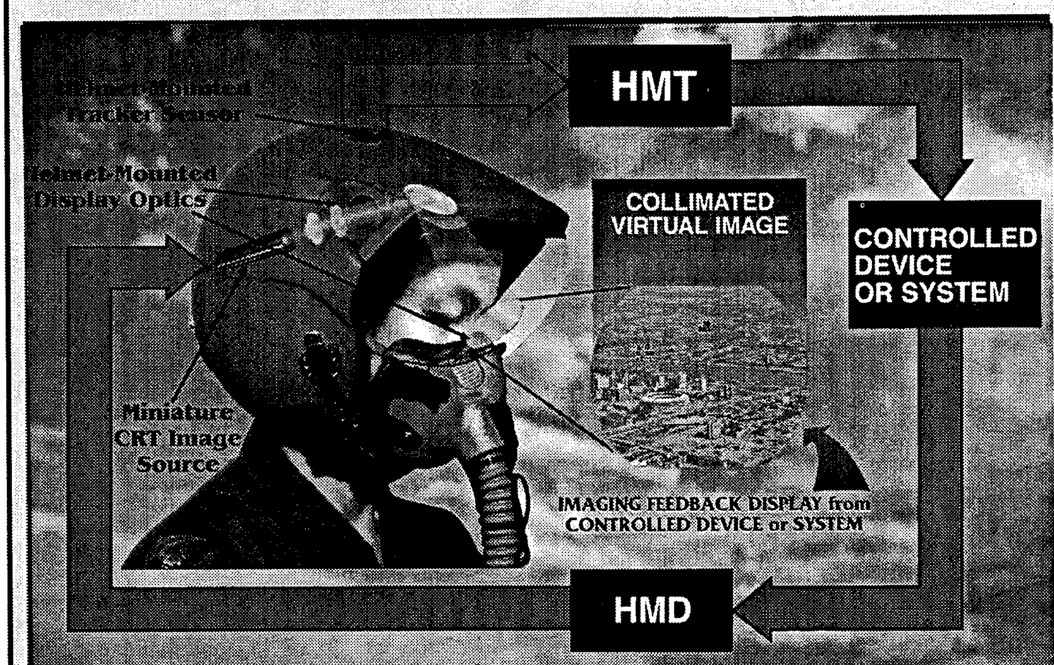


FIGURE 1-22: HMT/HMD CONTROL AND FEEDBACK LOOP
Combination of Helmet-Mounted Tracker (HMT) and Helmet-Mounted Display (HMD) forms a VCS with the human operator actively inserted into the control and feedback loop. (Task 718411)

The Super Cockpit Program was conceived under the visionary leadership of Dr. Tom Furness during Project Forecast II, which was an advanced planning exercise managed by the Air Force Systems Command in 1986. Dean Kocian, Michael Haas, and Dr. Robert Eggleston respectively, were selected to head up in-house hardware, software, and human factors R&D for the project. Dr. Wayne Martin played a key role in coordinating, managing, and documenting the myraid contacts and components of this complex R&D effort. The original concept was for "a revolutionary modular virtual crew station which communicates 3-D spherical awareness to the pilot or crew. Information from aircraft avionics, weapons, and sensors is fused, organized, and presented within a panoramic visual and auditory display surround for rapid assimilation by the pilot. The pilot directs weapons and commands aircraft systems by using line-of-sight, voice, and other natural psychomotor responses (Figure 1-23)". This program evolved into a 6.3 Advanced Demonstration Program, Helmet-Mounted Sensory Technology (HMST) presently managed by Randall Brown with Dean Kocian as Chief Engineer.

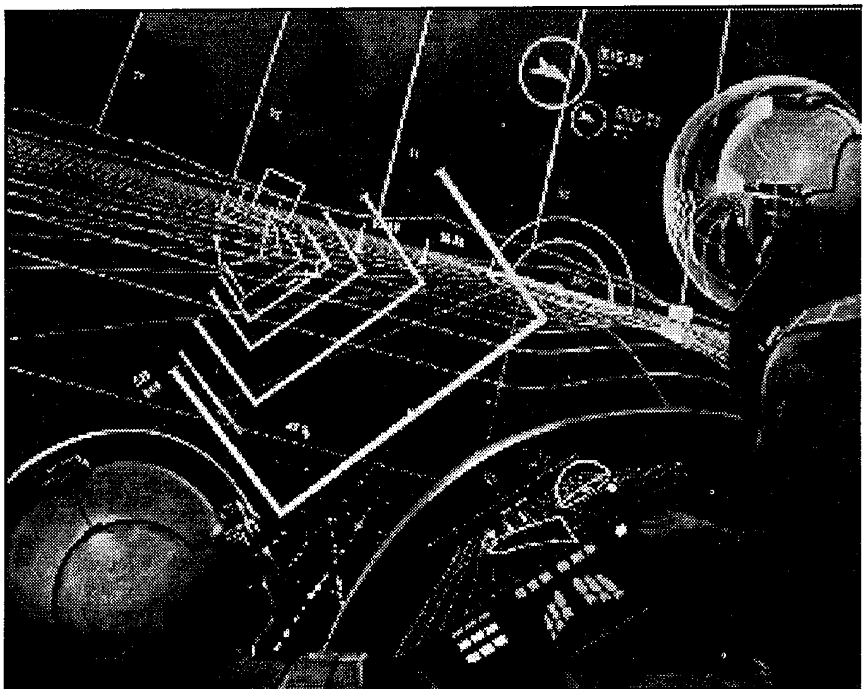


FIGURE 1-23: CONCEPTUAL DRAWING OF COCKPIT OF THE FUTURE

This widely disseminated artist's conception is a graphic portrayal of a virtual situation head-mounted display system for an encapsulated tactical environment. (Task 718426)

During Fall 1991, an international Super Cockpit program was formally initiated when the French and US Governments signed a Joint Memorandum of Understanding. The MOU involved three governmental organizations: the Human Engineering Division, Crew Systems Directorate of the Armstrong Laboratory at Wright-Patterson AFB; the CERMA in Bretigny, France; and the Section Etudes et Simulation, Centre D'Essais en Vol (CEV) in Istres, France. Nunn Amendment advanced development funding supporting the Super Cockpit Program began in December 1992. Dr. Kenneth Boff served as Program Manager and Michael Haas served as Technical Director and Chief Engineer.

The program was composed of two phases involving joint exploratory and advanced demonstration activity pursuing the design, development, and evaluation of control and display concepts utilizing multi-sensory, virtually augmented devices. The first phase consisted of the alignment of engineering research simulation facilities in the US and France. The second phase consisted of collaboration on the conceptual development and evaluation of virtually-augmented display and control concepts. During Phase One, Mike Haas, with the assistance of Chris Russell, directed the development of the SIRE Facility (Synthesized Immersion Research Environment) to create a synthetic environment for the rapid prototyping and evaluation of integrated virtual crew system concepts (Figure 1-24).

SIRE, which became operational in early 1994, consists of several autonomous research stations which can support individual research efforts or be combined to form a multi-participant virtual environment. One of the more striking research stations within the SIRE is a 40-foot diameter dome which includes a high-resolution, large field-of-view

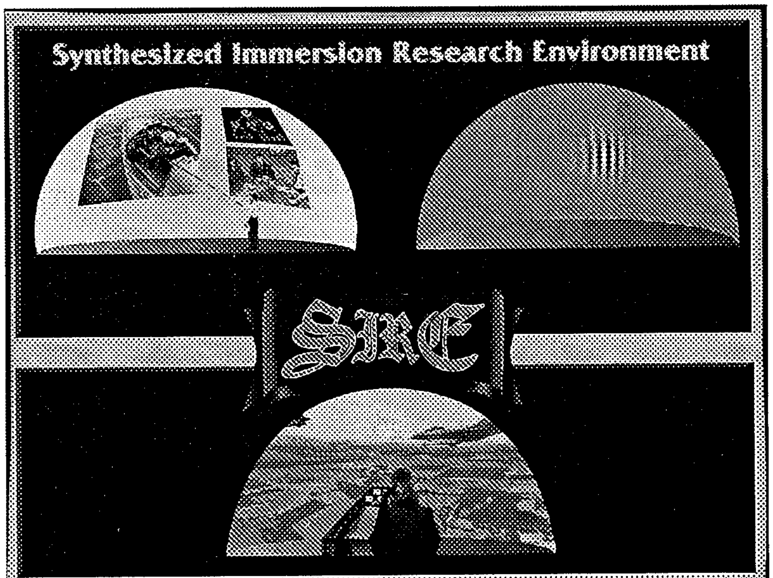


FIGURE 1-24: SYNTHESIZED IMMERSION RESEARCH ENVIRONMENT FACILITY

SIRE facility (Synthesized Immersion Research Environment) provides a synthetic environment for research in visual performance, assessment of virtual design techniques, and the rapid prototyping and evaluation of integrated virtual crew system concepts. (Task 718419)

(70 degrees vertical by 150 degrees horizontal) interactive visual display driven by a Silicon Graphics Onyx computer image generator, with auditory displays capable of presenting simulated three-dimensional, externalized sound information, and an electro-hydraulic control loader system to provide augmented haptic cueing information. The Synthesized Immersion Research Environment lab is a general purpose research environment that can be configured to perform applied research on the design of advanced human-vehicle interfaces, including aircraft and ground vehicles. It can also be configured to perform more fundamental research on multi-sensory perception and human performance in virtual environments.

The VEIL (Virtual Environment Interface Laboratory) was founded by Dr. Robert Eggleston with the goal of providing technical data to characterize how humans perform in synthetic environments or utilize virtual devices in the performance of tasks. In support of the Super Cockpit program, Dr. Eggleston established bench-mark tasks that could be used to evaluate virtual system characteristics in terms of human performance applicable to a wide range of task conditions.

Alternate Control Technologies

Helmet-Mounted Oculometer System: In 1981, Michael Haas coordinated the receipt of residual equipment from Air Force Project 2360, managed by the ASD Simulator System Program Office. The key component of this delivery was a Honeywell helmet-mounted oculometer consisting of an infrared corneal reflection eye-tracking system and a magnetic helmet sight system. This delivery served as the impetus for a new research facility spearheaded by Dr. Kenneth Boff. The Helmet-Mounted Oculometer Facility (Figure 1-25) was established to capitalize on the Honeywell system's unique capabilities for unobtrusive and accurate monitoring of eye and helmet positions. In this regard, Mr. Haas managed the expansion of this residual equipment into a full-scale research facility, capable of measuring and recording eye and head data under experimenter-specified task paradigms.

Gloria Calhoun assumed responsibility for the Helmet-Mounted Oculometer Facility from 1983 to 1991. During the period, this facility examined the potential of using an operator's eye line-of-sight as an alternative control interface. Research determined the spatial/temporal parameters for implementing the eye-control algorithm and quantified the efficiency of eye control compared to other control mechanisms. Additionally, alternative eye monitoring techniques were evaluated in an effort to facilitate integration with visually-coupled systems and define performance parameters for airborne applications. The results of these research efforts paved the way for revolutionizing the interface between the pilot and aircraft. Use of eye control eliminates the need for a selective manual response by substituting the natural movement of the eyes which are inherent to the visual task. For tasks in which the pilot's attention is directed out of the cockpit, eye control could enable the control portion of these tasks to be completed with the head out of the cockpit.

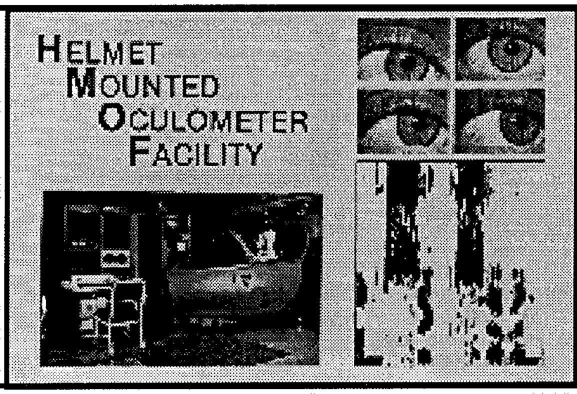


FIGURE 1-25: HELMET-MOUNTED OCULOMETER FACILITY
Both an eye tracker and voice recognizer were used to evaluate eye line-of-sight control with a verbal consent. (Workunit 71842602)

The Helmet-Mounted Oculometer Facility was also used during this time period to support other in-house research efforts. One was directed toward determining whether eye and head measures are valuable objective indicators of the effectiveness of attention cues and control/display design. Parameters of eye and head movements (e.g., sequence and latencies) were examined in comparison to the conventional performance index, manual reaction time, as a function of several factors: attention cue modality, task environment, attention allocation between tasks, and information location. In the case of cockpit design, this research suggests that these relatively nonobtrusive measures may be valuable indices for detecting a pilot's awareness of attention cues and changes in information presented. Another research effort examined the application of three-dimensional auditory signals to provide natural directional cueing. For example, the speed of target acquisition with a simulated aural directional cue was compared to conventional directional cues. The potential payoff of localized aural signals is the reduction in pilot workload together with an increase in situation awareness.

Brain-Actuated Control Research: This work grew out of research in the 1980s which examined the utility of the steady-state visual evoked response (SSVER) as an unobtrusive measure of cognitive workload. Subjects viewed a modulated light stimulus, and the brain response was evaluated as a function of the difficulty level of the primary task. Although this research did not show reliable sensitivity to task difficulty level, the variability in the SSVER data suggested that it was influenced by the subject's attentional state. To explore this further, a system was fabricated in 1987 to provide near real-time feedback on the EEG response to the evoking stimulus. The results of this closed-loop system still failed to show utility of the SSVER for workload measurement. However, subjects demonstrated their ability to regulate SSVER under various experimental paradigms, suggesting the exciting potential of using these brain responses as a direct link between mind and machine.

In 1989, Dr. Andrew Junker began to link the SSVER brain response feedback to a single-axis motion based simulator. Using biofeedback training, subjects learned to enhance or reduce the magnitude of their brain's response to a modulated light presented within a task display. These changes were then translated into commands that controlled the roll position of the simulator. The demonstration was a success, and subjects were able to operate the simulator using only brain-actuated control (Figure 1-26). However, it was evident control reliability and precision needed improvement before any application could be made.

In 1992, work resumed, under the direction of Maj Frank Fisher, to make significant system enhancements with the goal of improving signal acquisition and control efficiency. New control drive laws were developed for converting the brain response data into smooth, precise control signals. Ms. Gloria Calhoun assumed management of the effort in 1993, and directed the development of two new brain-actuated control task environments. In one, the brain-actuated control system was interfaced to a neuro-muscular stimulator, a device used to provide exercise for paralyzed limbs to illustrate potential rehabilitation applications of this innovative brain interface. In the second new task environment, subjects change the color of a displayed square to match the color of the square's border by modifying the magnitude of their brain response. This task environment is

currently being used in an effort to investigate the neurological mechanisms of brain-actuated control. Efforts are also underway to explore the utility of a brain interface for aircraft related tasks, such as radio and radar operation. This may be especially useful during high-G and high workload conditions.

A key to Armstrong Laboratory's advancements in brain-actuated control is the support provided by Dr. Grant McMillan. As manager of the Alternative Control Technology Program, Dr. McMillan has provided support and technological insight for system improvements and research direction. Moreover, Dr. McMillan can be credited with the significant publicity which the brain-actuated control program has enjoyed, including features in PBS's *Scientific American Frontiers*, ABC's *Good Morning America*, and CNN's *Future Watch* programs. In addition, this research has been highlighted in many publications, including *Discover*, *Air Force Magazine*, *Air and Space*, and *The World and I.*

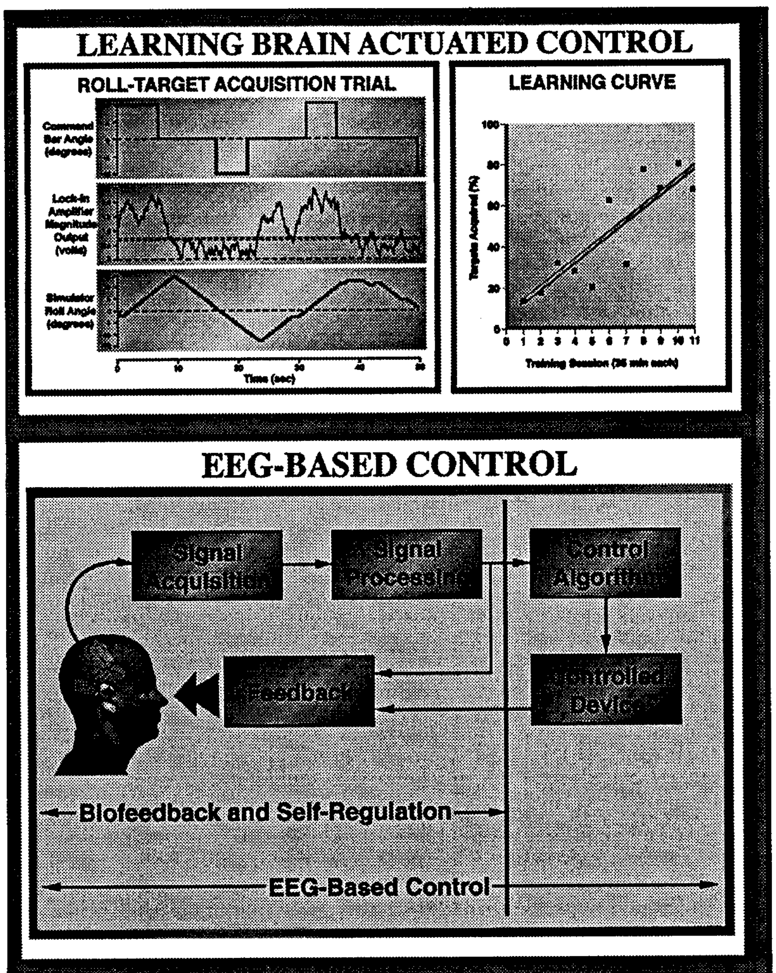


FIGURE 1-26: BRAIN ACTUATED CONTROL
Reliable EEG-based control of simulator roll angle achieved after four hours of training. EEG-based control is an extension of biofeedback methodology which translates EEG signals into control inputs. (Task 689306)

C. FACILITIES

In 1984, construction was completed on an extension to Building 248. This laboratory extension and accompanying modernization of the interior of 248 resulted in a doubling of available laboratory space to almost 70,000 sq ft. The resultant laboratory facility was primed to sustain its role as the pre-eminent human engineering research laboratory in the world. In 1985, the division was formally dedicated in honor of our founder as the Paul M. Fitts Human Engineering Division.

In January 1992, construction began on the Optical Systems Laboratory, a 200-foot long, self-supporting structure containing 14,500 sq ft of floor space joining Buildings 33 and 248 in Area B of Wright-Patterson Air Force Base. It contains five laboratories and has a horizontal window of special optical glass running its entire length, providing an unobstructed view to the West. Part of it is a structure resembling an airport control tower designed for tracking aircraft approaching the runway of Patterson Field in Area A. The tower facility will aid research in vision and the design and evaluation of helmet-mounted display systems, such as visually-coupled systems. It also has a spherical dome resembling a small observatory to be used for tracking aircraft and scanning the terrain. The new structure was completed in October 1993 (Figure 1-27).

D. ADMINISTRATION & MANAGEMENT

There can be little doubt of the value added from "50 Years of Human Engineering." The impact of our many technological successes and products has been felt and reported back to us from across the private and public sectors, around the country, and from many parts of the world. Less visible, but nonetheless a fundamental basis to these successes, have been the contributions of those professionals committed to the administrative and support functions of the organization. These include the branch chiefs, secretarial staff, technical editors, data processor managers, and administrators in accounting, contracting, personnel, travel, equipment, facilities, and support contracts. Though often unrecognized, these dedicated individuals collectively contributed greatly to the productivity, esprit de corps, and total quality of the divison and its products.

Take branch offices, for example. Made up of a branch chief and secretary, a successful branch office provides the full range of personnel, scientific, management, and support functions needed to allow branch members to be productive and to prosper. Branch chiefs generally are expected to split time between a full schedule of personnel duties and an equally full slate of technical duties—to be scientists, managers, leaders, motivators, disciplinarians, planners, and communicators. Secretaries, on the other hand, are expected to know how to do everything—and generally do. They are assigned a long list of duties, none of which captures the fact that they are primarily problem solvers and defacto assistant branch chiefs. Often they are the last link in the chain, the ones who get scribbled drafts at 3:45 P.M. that need to be in final form, coherent, proofread, and in ten copies by 4:00 PM. The finest secretarial work can easily go unnoticed because it tends to eliminate the problems and reduce the turmoil that normally command our attention.

The Human Engineering Division was graced over the last ten years, with a succession of branch offices of uncommon skill and effectiveness. The list below contains the names of prominent members of branch offices from that period arranged, roughly, by branch history.

Chiefs:	Secretaries:
Dr. Tom Furness Dr. Wayne Martin Lt Col Mel O'Neal Lt Col Mike Eller	Tanya Ellifritt Yolanda Crawford Theresa Schiavone
Capt Lee Penick Walt Summers	Cheryl Dunaway Rebecca Green Carole Patrick Sheila Radford Renee Kaffenbarger Anne Cato
Maj Lonnie Roberts Lt Col Bill Marshak Lt Col Mike Eller Lt Col Jim LaSalvia	Sharon Sain Tina Sanford Mary Louise Smith
Lt Col Lou Genco Lt Col Al Dickson Lt Col Mel O'Neal Dr. Grant McMillan Maj Ed Fix Maj Julie Cohen	Joanne Myers Laura Mulford
Maris Vikmanis	Marya Beverly
Dr. Clyde Replogle	Karen Unfried Betty Adams

The division office was equally blessed with gifted and tireless secretaries, including Barbara Osman, Suzanne Daly, and Betsy Combs. Each brought exacting standards to the job, thereby establishing and maintaining a tradition of business excellence. Their leadership has been invaluable.

Administration of the intangible resources entails personnel record keeping, budgeting, purchase request processing, expenditure tracking, STINFO, program and financial reporting, travel, manhour accounting, and several others. Originally administrated by the legendary Sandy Stevenson, these duties,

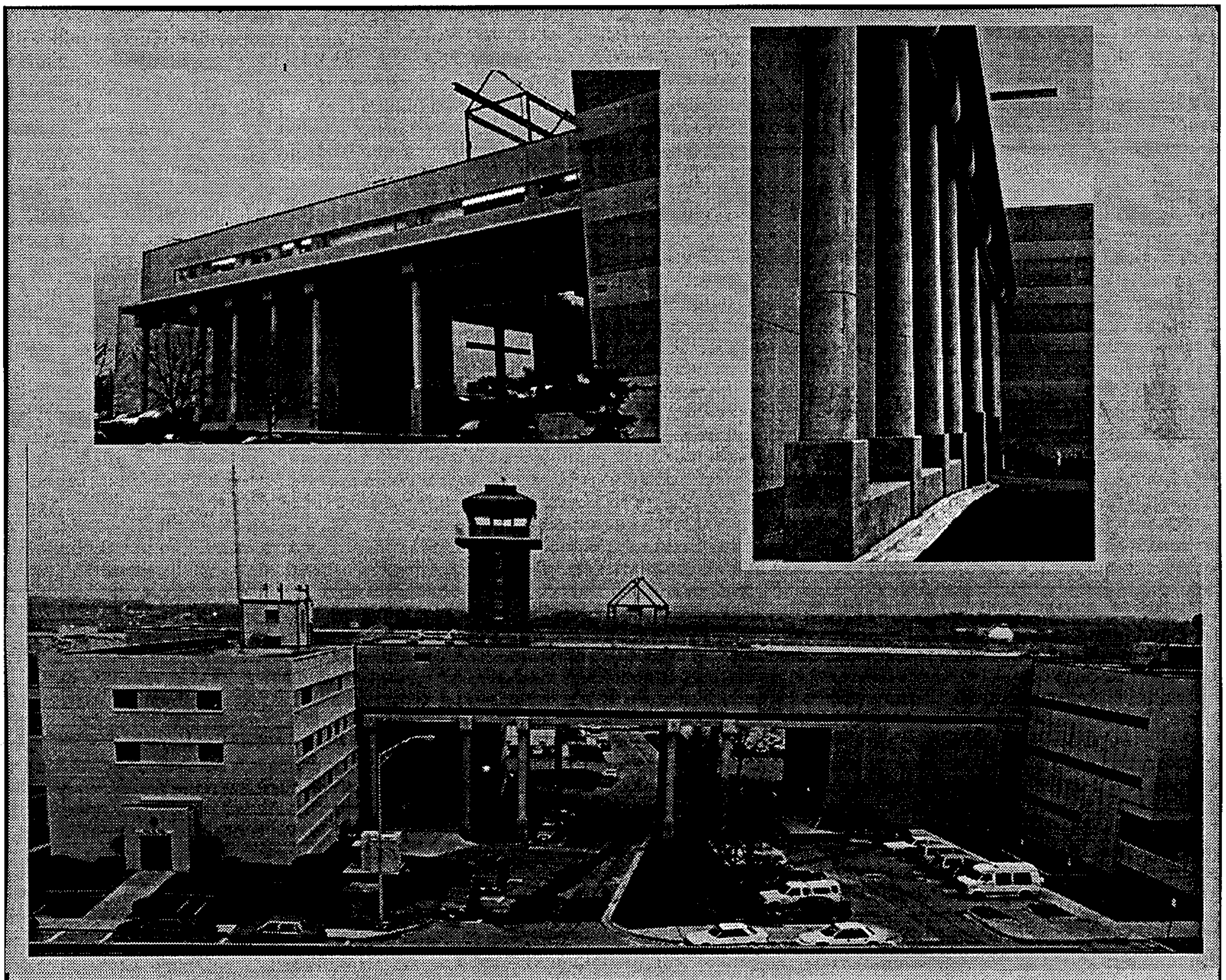


FIGURE 1-27: VARIOUS VIEWS OF THE HUMAN ENGINEERING DIVISION COMPLEX

swollen by ever-increasing reporting requirements, are now managed by the highly decorated, all-star team of Helen Redwine-Smith and Becky Green. The well-being of our tangible resources, e.g., our four primary buildings and their contents, was the responsibility of our real property managers, Al Chapin, SMSgt Dale Schimmel, and MSgt Bob Stewart. Each, during his tenure here, provided the Human Engineering Division with award-winning support. Two military construction projects and an in-progress, four-year infrastructure overhaul were handled with craftsman-like skill bringing the division's facilities in line with the finest in DOD. Mail distribution, travel orders processing, and similar duties were handled with dedication and superior know-how by TSgt Rob Johnson, SSgt Joe Gregory, and, more recently, SSgt Otis Newsome. A well deserved tip of the cap also goes to the really unsung heroes of the division--the managers of equipment and computer accounts, security, technical orders, hazardous material accounting, and many more.

Four contracts have provided broad technical support to the division over the last ten years. The largest, and most widely used, was held originally by Systems Research Laboratories (SRL), and now is held by Logicon Technical Services, Inc. (LTSI). During the majority of the ten-year span, these contracts were ably managed by Bob Linhart. With Bob's reassignment to another

division in early Spring 1994, management responsibility passed to our professional engineer, Bob Centers. When Bob Centers retired, the contract was passed to 1st Lt Bryan Christensen. Each of these managers served with distinction, making this contracted effort a support cornerstone of the division's research program and a model for all DOD laboratories. Much the same can be said about the success of Tom Green, Don McKechnie, and 1st Lt Bryan Christensen as managers of the division's strategic systems support contract with Scientific Applications International Corp. (SAIC) over the same period. Though somewhat less active, the rapid prototyping contract, held first by the University of Dayton Research Institute (UDRI) and BDM Corporation, and more recently by UDRI alone, was skillfully let and managed by Randy Yates. It provided off-site engineering services in the rapid preparation of prototypes of human-system interface components in a form ready for evaluation, such as flight test. Somewhat different is the CSERIAC (Crew System Ergonomics Information Analysis Center) contract, also with UDRI, but let through the Defense Technical Information Center (DTIC). One of only a score of DOD information analysis centers, CSERIAC is sponsored by the Human Engineering Division and provides the international human engineering community with a center of excellence in ergonomics and a gateway to ergonomics information and expertise worldwide. This ambitious venture owes much of its considerable success to a cadre of Air Force personnel, including Dr. Lew Hann as Program Manager, Tanya Ellifritt as Program Administrator, and Dr. Kenneth R. Boff as Technical Director.

The use of computers in the Human Engineering Division has followed closely behind the state-of-the-art, though remaining just far enough behind to ensure system reliability and full functionality. The first computer "network" connecting all members of the division computationally was designed by Bob Centers, assisted by personnel of Systems Research Laboratories. The system was a mainframe-based structure which provided electronic mail, file transfer, bulletin boards, and access to ARPANET, on a VAX mini-computer. The overall ADPE, or automated data processing equipment, program was managed by Walt Summers. In the early 1990s, management of the ADPE program was transitioned to Randy Yates, under whose insightful and energetic guidance (with support from Logicon Technical Services personnel), the system progressed to a full local area network, or LAN. Today's LAN offers full office automation, an inexpensive microcomputer-based architecture, full compatibility between Apple and PC computers, access to Internet, and much more. In a companion effort, Bob Centers and Randy Yates, with participation from Al Chapin, MSgt Bob Stewart, TSgt Wiley Wells, and others, developed an ultra-modern multi-media room which combines state-of-the-art audio and video presentation capabilities under convenient and powerful computer control—a conference room of the future.

SECTION 2 - 50 YEARS OF HUMAN ENGINEERING: BIBLIOGRAPHY

About This Bibliography

The unclassified publications of the Human Engineering Division over the fifty years of its existence are presented in ten-year intervals in the present document. During this time period, the division participated in many projects that had security classifications as did the documentation about the work. The bibliography necessarily omits the titles of documents that had security classifications.

Some of the research and development work of the Human Engineering Division is published outside of the government in the journals and proceedings of scientific and technical societies and other organizations, and as chapters in books. An appreciable part of the division's work also appears in official publications of the US Government. These publications by the government include books, such as *The Engineering Data Compendium* and *Human Factors Issues in Head-Up Displays*, as well as handbooks and parts of handbooks, military specifications and standards, special reports and technical reports.

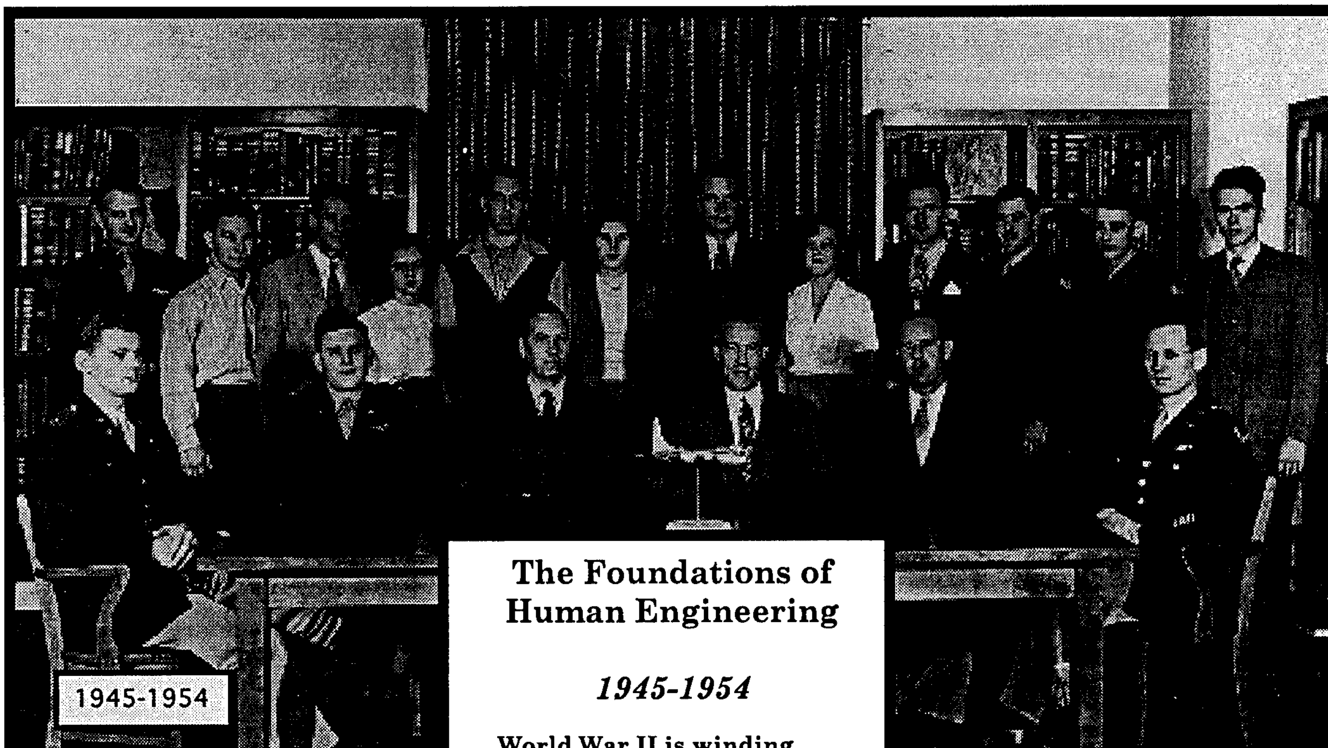
Technical reports are the Human Engineering Division's most common form of publication within the US Government. Prior to publication, these reports are reviewed by division personnel other than the authors, and permission to publish and release to the general public is granted only after examination by government personnel outside the Human Engineering Division. Technical reports by the division do not receive pre-publication peer review by individuals outside of the government, and division technical reports are neither as widely disseminated nor as readily available as journal articles.

However, technical reports are available to the public and have some advantages that sometimes make them a preferable form of publication. For example, there are no suitable journals for publishing tutorial reports, reports on research and development on military hardware, and extensive documentation on the data collections by the division's physical anthropologists on subjects such as human body dimensions and strength in executing various tasks. Technical reports can be considerably longer than journals will accept, hence they can report appreciably more details about the work. Technical reports permit publishing more pictures and other forms of illustration than are available in journal articles. Most of the pictures in the present document are excerpted from Human Engineering Division technical reports.

The designations of technical reports can be confusing to people not acquainted with them. In addition to their titles, government technical and scientific reports are identified by technical report labels. AAMRL-TR-89-001 is an example of a report designation. The title of this report is Display System Analysis for the LHX Helicopter Applications. Here, the letters, the alphabetic preface, designate the laboratory or other government organization that published the report. The TR stands for technical report, the first set of numbers identify the year that the report was published, and the last set of numbers designate the report's chronological order in the publication year. The translation of the designation of the above example is that the report was published by the Armstrong Aerospace Medical Research Laboratory in 1989 and is the first technical report for the year. The report numbers do not take into account journal articles or other forms of division publications within or outside of the government.

Since the laboratory name has changed over the years and since other government organizations sometimes have published works of the Human Engineering Division, the acronyms of the alphabetic preface of technical reports can be confusing and require clarification. Some of the more frequent acronyms used in the designations of division technical reports are as follows:

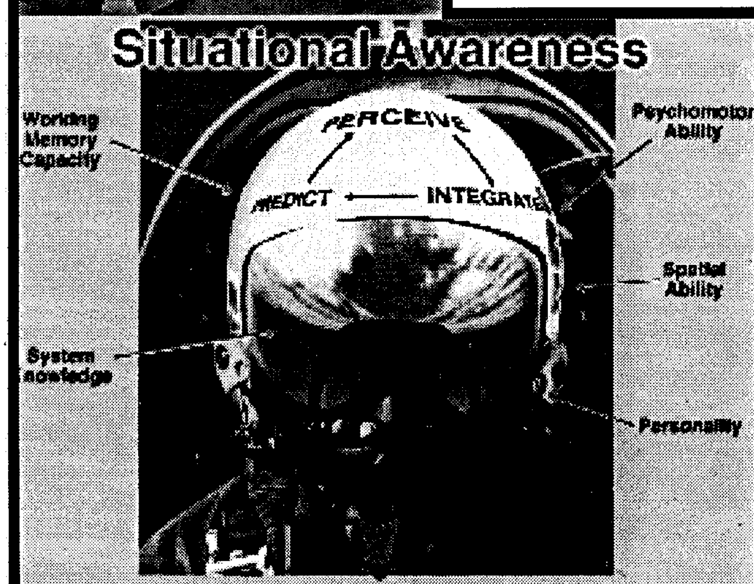
AF	**Air Force**
AAMRL	**Armstrong Aerospace Medical Research Laboratory**
AFB	**Air Force Base**
AL	**Armstrong Laboratory**
AMC	**Air Materiel Command**
AMRL	**Aerospace Medical Research Laboratory**
ASD	**Aeronautical Systems Division**
DTIC	**Defense Technology Information Center**
MRL	**Medical Research Laboratory**
TDR	**Technical Documentary Report**
USAF	**United States Air Force**
WADC	**Wright Air Development Center**
WADD	**Wright Air Development Division**



The Foundations of Human Engineering

1945-1954

World War II is winding down. Performance of many weapons during the war has been disappointing. Human failure is evident, but serious questions are raised regarding the suitability of the design of many of these weapons for human use. A 29 May 1945 Air Staff directive dictates "that facilities be established for conducting scientific psychological research on problems of aviation equipment" at Wright Field, Dayton, Ohio. The Psychology Branch of the Aero Medical Laboratory is born and with it the fledgling field of human engineering.



Adler, H. E., Brown, J. L., & Herrick, R. M. (1954). *The effects of pupil size and flash duration on acuity during dark adaptation* (WADC Technical Report 54-551). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 63 261)

Adler, H. E., Kuhns, M. P., & Brown, J. L. (1953). *Masking of cathode ray tube displays by ambient illumination* (WADC Technical Report 53-266). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 30 677)

Allen, M. J., Fitts, P. M., & Slivinske, A. J. (1954). *A moving target optical projector for use in air traffic control research* (WADC Technical Report 53-417). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 30 062)

Ammons, R. B. (1954). *Knowledge of performance: Survey of literature, some possible applications, and suggested experimentation* (WADC Technical Report 54-14). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 34 643)

Anderson, N. H., Grant, D. A., & Nystrom, C. O. (1954). *Performance on a repetitive key pressing task as a function of the spatial positioning of the stimulus and response components* (WADC Technical Report 54-76). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 34 416)

Archer, E. J. (1954). *Identification of target concepts as a function of information load* (WADC Technical Report 54-202). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 35 129)

Archer, E. J. (1954). Identification of visual patterns as a function of information load. *Journal of Experimental Psychology, 48*, 313-317.

Archer, E. J., Wyckoff, L. B., & Brown, F. G. (1954). *Tracking performance as measured by time continuously on target* (WADC Technical Report 54-210). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 35 128)

Baker, C. A. (1954). Interpolation accuracy as a function of visual angle between scale marks. *Journal of Experimental Psychology, 45*, 433-436.

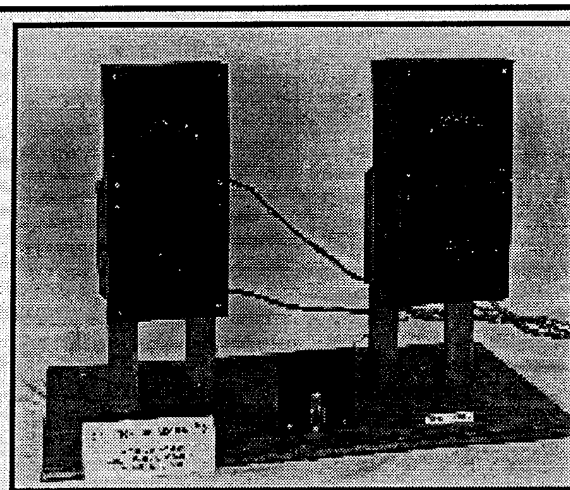
CHECK READING GROUPS OF DIALS
Measuring the effects of dial diameter on eye movements and the speed and accuracy of check reading groups of 16 engine instruments. The study was used to provide data on which to base recommendations for instrument panel design. The work was done by William J. White. Air Force Technical Report No. 5826 (1949)

Baker, C. A., & Carter, G. H. (1954). *Design of an aircraft clock dial* (WCRD Technical Note 54-22). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 119 092)

Baker, C. A., & Grether, W. F. (1954). *Visual presentation of information* (WADC Technical Report 54-160). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 43 064)

Barger, D. M., & Roush, R. G. (1953). *A velocity modulated raster display for brightness discrimination studies* (WADC Technical Report 53-249). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 23 712)

Benepe, O. J., Narasimhan, R., & Ellson, D. G. (1954). *An experimental evaluation of the application of harmonic analysis to the tracking behavior of the human operator* (WADC Technical Report 53-384). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 38 148)



RELATIVE ROTATION DIRECTION OF DIALS AND CONTROLS

Determining the effects of the relative direction of rotation of dials and control knobs on the speed and accuracy of adjustment in alternating the positioning of two semicircular dial indicators with rotary knobs. This was one of four experiments described in the report by Melvin J. Warrick. AF Technical Report No. 5812 (1949)

Biel, W. C., Eckstrand, G. A., Swain, A. D., & Chambers, A. N. (1952). *Tactual discriminability of two knob shapes as a function of their size* (WADC Technical Report 52-7). Wright-Patterson AFB, OH: Wright Air Development Center.

Bitterman, M. E., & Krauskopf, J. (1953). *Some determinants of the threshold for visual form* (WADC Technical Report 53-331). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 23 337)

Bradley, J. V. (1954). *Control-display association preferences for ganged controls* (WADC Technical Report 54-379). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 52 499)

Bradley, J. V. (1954). *Desirable control-display relationships for moving-scale instruments* (WADC Technical Report 54-423). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 61 819)

Bridgman, C. S., & Wade, E. A. (1953). *Sensitivity to changes in stimulus size: Reaction time as a function of rate of change* (WADC Technical Report 53-199). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 20 543)

Brown, C. W., Ghiselli, E. E., Jarrett, R. F., & Minium, E. W. (1948). *Comparative effectiveness of speed of detection of visual stimuli in the prone and seated positions* (AMC Memorandum Report MCREXD-694-4I). Wright-Patterson AFB, OH: Air Materiel Command.

Brown, C. W., Ghiselli, E. E., Jarrett, R. F., Minium, E. W., & U'Ren, R. M. (1947). *Speed and accuracy of spatial location in the prone position* (AMC Memorandum Report MCREXD-694-4H). Wright-Patterson AFB, OH: Air Materiel Command.

Brown, C. W., Ghiselli, E. E., Jarrett, R. F., Minium, E. W., & U'Ren, R. M. (1949). *Magnitude of forces which may be applied by the prone pilot to aircraft control devices: I. Three-dimensional hand controls* (AMC Memorandum Report MCREXD-694-4J). Wright-Patterson AFB, OH: Air Materiel Command.

Brown, C. W., Ghiselli, E. E., Jarrett, R. F., Minium, E. W., & U'Ren, R. M. (1950). *Comparison of aircraft controls for prone and seated position in three-dimensional pursuit task* (AF Technical Report 5956). Wright-Patterson AFB, OH: Air Materiel Command.

Brown, C. W., Ghiselli, E. E., Jarrett, R. F., Minium, E. W., & U'Ren, R. M. (1950). *Magnitude of forces which may be applied by the prone pilot to aircraft control devices: II. Two-dimensional hand controls* (Technical Report 5954). Wright-Patterson AFB, OH: Air Materiel Command.

Brown, C. W., Ghiselli, E. E., Jarrett, R. F., Minium, E. W., & U'Ren, R. M. (1950). *Magnitude of forces which may be applied by the prone pilot to aircraft control devices: III. Foot controls* (AF Technical Report 5955). Wright-Patterson AFB, OH: Air Materiel Command.

Brown, J. L. (1952). *The effect of different preadapting luminances on the resolution of visual detail during dark adaptation* (WADC Technical Report 52-14). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 5277)

Brown, J. L., Diamond, A. L., & Adler, H. E. (1952). *The effect of duration of light adaptation on time required for detection of a target on a simulated PPI scope* (WADC Technical Report 52-259). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 12 969)

Lieutenant Colonel Paul M. Fitts, PhD

Chief, Psychology Branch

1945 to 1949

Lt Col Paul M. Fitts is generally regarded as the father of human engineering as a technical discipline.

He received degrees in psychology from the University of Tennessee (BS 1934), Brown University (MS 1936), and University of Rochester (PhD 1938) prior to being commissioned in the Army Air Force as a first lieutenant in the Aviation Psychology Program in April 1942. During most of the war years, he served as Assistant Chief of the Psychology Branch in the Office of the Air Surgeon, HQ USAAF. His major function was providing direction for the several field units of the Aviation Psychology Program.

At the end of the war in Europe, Fitts was dispatched to Germany for a three-month intelligence mission to investigate the Luftwaffe approach to the use of scientific psychology in support of military operations. In 1945, he developed a plan for a psychological research unit that would address man-equipment engineering design problems that underlie aircraft accidents, bombing errors, and other such phenomena that are evidence of human failures attributable to poor engineering design. The Air Staff approved his proposal on 19 May 1945 and he became the Chief of the Psychology Branch of the Aero Medical Laboratory. He served in this position until 1949.

His subsequent career included Professor of Psychology and Directorship of the Aviation Psychology Laboratory at The Ohio State University, Professor of Psychology and Head of the Human Performance Center of The University of Michigan, and membership on several research and development boards.

At the time of his death, on 2 May 1965, Dr. Fitts was serving as a National Research Council scientific coordinator for human performance issues relative to the Manned Orbiting Laboratory. Dr. Fitts' many contributions to the Air Force are well documented in both the scientific literature and in the methods, techniques, and disciplines applied today in the development of Air Force weapon systems. It was in light of Dr. Fitts' profound influence on the technology and programs of the United States Air Force and the Harry G. Armstrong Aerospace Medical Research Laboratory, that Building 248, Area B, Wright Patterson Air Force Base, was memorialized in his honor as the Paul M. Fitts Human Engineering Laboratory.

Brown, J. L., Graham, C. H., Leibowitz, H. W., & Ranken, H. B. (1952). *Luminance thresholds for the resolution of visual detail during dark adaptation* (WADC Technical Report 52-12). Wright-Patterson AFB, OH: Wright Air Development Center.

Brown, K. T. (1953). Factors affecting differences in apparent size between opposite halves of a visual meridian. *Journal of the Optical Society of America, 43,* 464-472.

Brown, K. T. (1953). *Factors affecting rate of apparent change in a dynamic ambiguous figure as a function of observation time* (WADC Technical Report 53-482). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 34 415)

Brown, K. T. (1954). *Studies on rate of apparent change as a function of observation, using a new type of dynamic ambiguous figure* (WADC Technical Report 54-139). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 50 077)

Brown, K. T., & Grether, W. F. (1952). *The effects of pure red and low-color-temperature white instrument lighting upon dark-adapted visual thresholds* (AF Technical Report 6470). Wright-Patterson AFB, OH: Wright Air Development Center.

What is now the Behavioral Sciences Laboratory began with the establishment of the Psychology Branch in the Aero Medical Laboratory at Wright Field in the closing days of World War II (August 1945). One of the first arrivals was Paul M. Fitts, then a lieutenant colonel, who was primarily responsible for organizing the new branch and served as its chief until 1949. Other psychologists among the initial staff were Robert M. Gagne, Walter F. Grether, Launor F. Carter, Judson S. Brown, John T. Cowles, William O. Jenkins, M.J. Warrick, Julien M. Christensen, A.P. Johnson, H.R. Van Saun, Glen Finch, and W.B. Webb. These and others among the early staff were members of the Army Air Force's Aviation Psychology Program, where they had worked on aircrew selection, training and rehabilitation. With the end of World War II many of the staff separated, and the branch became more stabilized with a staff of about 25 people.

— March 1965, "Human Engineering and Training Research Division," Behavioral Sciences Laboratory

Buckley, B. B., Hanes, R. M., & Deese, J. (1953). *Search area and target detectability on a PPI cathode-ray tube* (WADC Technical Report 52-203). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 13 298)

Burke, C. J., Narasimhan, R., & Benepe, O. J. (1953). *Some problems in the spectral analysis of human behavior records* (WADC Technical Report 53-27). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 18 754)

Carter, L. F. (1946). *The relative effectiveness of presenting numerical data by the use of tables and graphs* (AMC Memorandum Report TSEAA-694-1). Wright-Patterson AFB, OH: Air Materiel Command.

Carter, L. F. (1946). *A study of the best design of tables and graphs used for presenting numerical data* (AMC Memorandum Report TSEAA-694-1C). Wright-Patterson AFB, OH: Air Materiel Command.

Chalmers, E. L., Goldstein, M., & Kappauf, W. E. (1950). *The effect of illumination of dial reading* (AF Technical Report 6021). Wright-Patterson AFB, OH: Air Materiel Command.

Cheatham, P. G. (1950). *A comparison of the visual senses as possible channels for communication* (AF Technical Report 5919). Wright-Patterson AFB, OH: Air Materiel Command.

Chiles, W. D. (1954). Performance during stimulation of the diencephalic activating system. *The Journal of Comparative and Physiological Psychology, 47.*

Christensen, J. M. (1946). *Psychological factors involved in the design of air navigation plotters* (Memorandum Report TSEAA-694-1D). Wright-Patterson AFB, OH: Air Materiel Command.

Christensen, J. M. (1946). *Some typical sky and earth brightnesses at altitudes 10,000 to 40,000 feet and their relationship to the eye-adaptation problems of the radar operator* (AMC Memorandum Report TSEAA-694-11). Wright-Patterson AFB, OH: Air Materiel Command.

Christensen, J. M. (1947). *Aerial analysis of navigator duties with special reference to equipment design and workplace layout: I. Development of technique* (AMC Memorandum Report TSEAA-694-15). Wright-Patterson AFB, OH: Air Materiel Command.

Christensen, J. M. et al. (1947). Research relating to graduation policy, grading system and instruction. In L. F. Carter (Ed.), *Psychological Research on Navigator Training: Army Air Forces Aviation Psychology Program Research Report 10.*

Christensen, J. M. (1948). *Aerial analysis of navigator duties with special reference to equipment design and workplace layout: III. Report on interviews with navigators of a photo reconnaissance squadron and a weather reconnaissance squadron assigned to Arctic duty* (AMC Memorandum Report MCREXD-694-15B). Wright-Patterson AFB, OH: Air Materiel Command.

Christensen, J. M. (1948). *The effect of staircase scale on dial reading accuracy* (AMC Memorandum Report MCREXD-694-1P). Wright-Patterson AFB, OH: Air Materiel Command.

Christensen, J. M. (1948). The sampling method of activity analysis and its application to the problem of aircraft crew requirements. *Scientific methods for use in the investigation of flight crew requirements: Section II.* Flight Safety Foundation: Woods Hole, Massachusetts.

Christensen, J. M. (1949). An analysis of the activities of the Arctic aerial navigator. *Technical Data Digest, 14,* 12-21.

Christensen, J. M. (1949). *AN/CPS-6B prototype inspection* (AMC Memorandum Report MCREXD-694-18C). Wright-Patterson AFB, OH: Air Materiel Command.

Christensen, J. M. (1949). *In-flight activities of navigators in the Atlantic and Pacific areas* (AF Technical Report 5771). Wright-Patterson AFB, OH: Air Materiel Command.

Christensen, J. M. (1949). A method for the analysis of complex activities and its application to the job of the Arctic aerial navigator. *Mechanical Engineering.*

Christensen, J. M. (1950). *A comparison of navigator activities in the high and mid-latitudes* (AF Technical Report 6027). Wright-Patterson AFB, OH: Air Materiel Command.

Christensen, J. M. (1950). The sampling technique for use in activity samples. *Personnel Psychology, 3,* 361-368.

Christensen, J. M. (1951). *Psychological research projects of selected British laboratories and establishments* (USAF Memorandum Report WCRDP-694-24C). Wright-Patterson AFB, OH: Wright Air Development Center.

Christensen, J. M. (1952). *Quantitative instrument reading as a function of dial design, exposure time, preparatory fixation, and practice* (WADC Technical Report 52-116). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 101)

Christensen, J. M. (1952). *Research projects of certain laboratories and establishments that relate to air defense* (WCRD Technical Memorandum Report 52-95). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 5278)

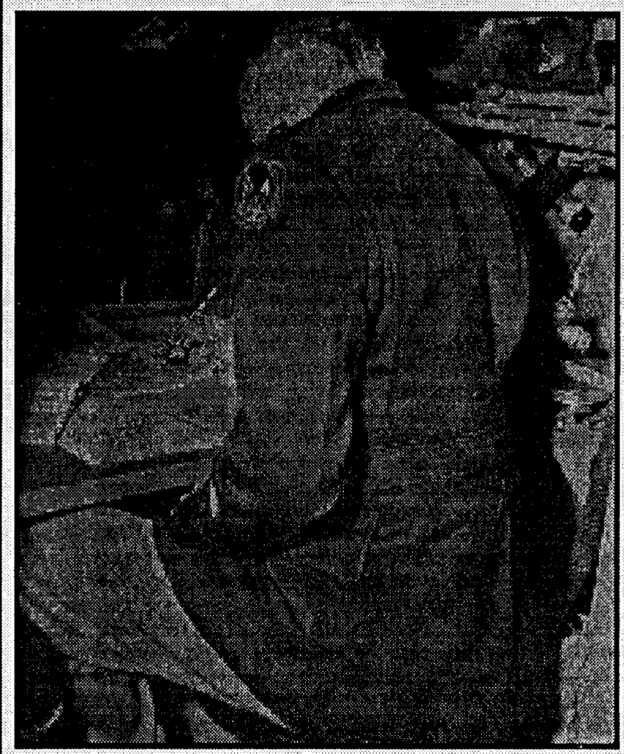
Churchill, E., & Daniels, G. S. (1953). *Nomographs of head movements* (WADC Technical Report 53-14). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 16 748)

Coakley, J. D., & Barmack, J. E. (1950). *A survey and analysis of the ground observer net: A human engineering study* (AF Technical Report 6032). Wright-Patterson AFB, OH: Air Materiel Command.

Coakley, J. D., Fogg, R. A., & Barmack, J. E. (1953). *Present intercept communication loads and their implications for visual-verbal message presentation* (WADC Technical Report 52-343). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 13 775)

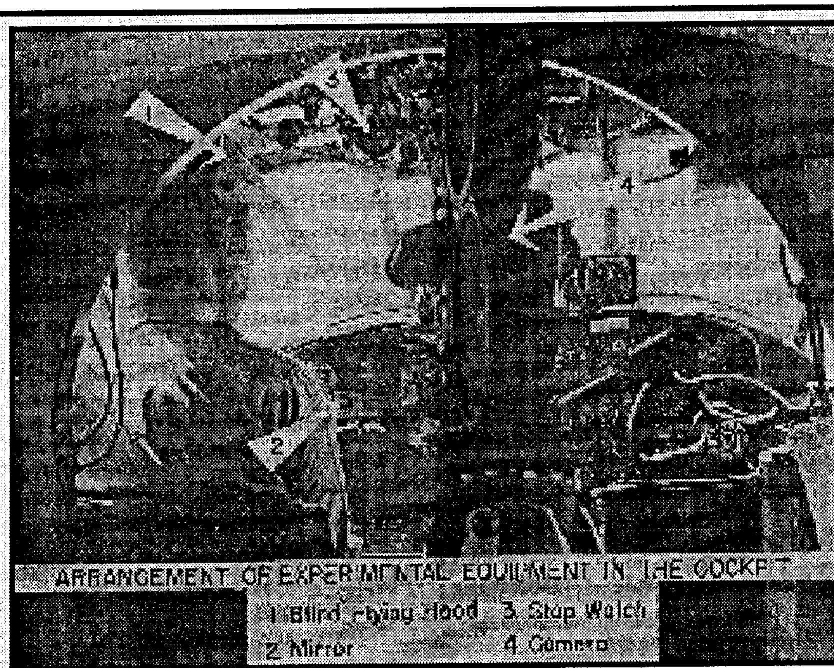
Coakley, J. D., & Fucigna, J. T. (1950). *A comparison of the speed and accuracy of aircraft indication with a PPI projection system and a conventional system* (AF Technical Report 6033). Wright-Patterson AFB, OH: Air Materiel Command.

Coakley, J. D., & Fucigna, J. T. (1950). *An evaluation of a GCI projection plotting board used as a conventional board* (AF Technical Report 6034). Wright-Patterson AFB, OH: Air Materiel Command.



WORKSTATION DESIGN AND OPERATIONAL EFFICIENCY

Navigator working in C-54 cargo aircraft from a report on the activities of navigators in the Atlantic and Pacific areas. This work was part of a project in which data on the activities of crew members under operational conditions were collected to determine minimum crew requirements and to make changes in equipment and workstations to increase operational efficiency. Julien Christensen performed this research. AF Technical Report No. 5771 (1949)



RECORDING PILOT EYE FIXATIONS

Technique for recording the frequency, duration, and sequence of pilot eye fixations during instrument flight. This report describes the results of a series of related investigations conducted by the Psychology Branch. The report was authored by Capt Richard E. Jones, 1st Lt John L. Milton, and Paul M. Fitts. USAF Technical Report No. 5837 (1949)

Coakley, J. D., Fucigna, J. T., & Barmack, J. E. (1953). *A functional application of anthropometric data to the design of the workspace of PPI Scope Operators* (WADC Technical Report 53-3). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 6164)

Coakley, J. D., Fucigna, J. T., & Barmack, J. E. (1953). *A systems description of the continental air defense net* (WADC Technical Report 52-186). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 22 782)

Coakley, J. D., Werner, D. S., Fucigna, J. T., & Barmack, J. E. (1951). *Classifying and quantifying communications between controllers and pilots obtained during simulated intercept missions* (AF Technical Report 6524). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 2136)

Cohen, J., & Senders, V. L. (1954). *Factors affecting the frequency of various final digits* (WADC Technical Report 55-371). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 99 566)

Cohen, J., Vanderplas, J. M., & White, W. J. (1953). Effect of viewing angle and parallax upon accuracy of reading quantitative scales. *Journal of Applied Psychology, 37,* 482-488.

Cohen, J., & Webb, I. B. (1953). *An experiment on the coding of numerals for tape presentation* (WADC Technical Report 54-86). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 43 529)

Cole, E. L., McIntosh, B. B., & Grether, W. F. (1950). *Brightness levels of three instrument lighting systems used by pilots flying at night* (AF Technical Report 6031). Wright-Patterson AFB, OH: Air Materiel Command. (DTIC No. 89 591)

Cole, E. L., Milton, J. L., & McIntosh, B. B. (1954). *Routine maneuvers under day and night conditions, using an experimental panel arrangement: The ninth of a series of reports on eye fixations of aircraft pilots* (WADC Technical Report 53-220). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 35 161)

Collins, H. R. (1952). *Methods of indicating aircraft heading* (WCRD Technical Note 52-65). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 66 657)

Connell, S. C. (1947). *The relative effectiveness of presenting numerical data by the use of scales and graphs* (AMC Memorandum Report TSEAA-694-1M). Wright-Patterson AFB, OH: Air Materiel Command. (DTIC No. 105 857)

Connell, S. C. (1950). *Some variables affecting instrument check reading* (AF Technical Report 6024). Wright-Patterson AFB, OH: Air Materiel Command.

Craig, D. R. (1949). *Effect of amplitude range on duration of responses to step function displacements* (AF Technical Report 5913). Wright-Patterson AFB, OH: Air Materiel Command.

Craig, D. R., & Ellson, D. G. (1948). *A comparison of one-handed and two-handed tracking* (AMC Memorandum Report MCREXD-694-2M). Wright-Patterson AFB, OH: Air Materiel Command.

Craig, D. R., & Ellson, D. G. (1948). *A comparison of various manipulative techniques in a tracking task* (AMC Memorandum Report MCREXD-694-2L). Wright-Patterson AFB, OH: Air Materiel Command.

Crocker, M. L., & Kennedy, J. L. (1947). *A study of preferences for abbreviations of common words used in aviation* (AMC Memorandum Report TSEAA-694-1I). Wright-Patterson AFB, OH: Air Materiel Command.

Crook, M. N., & Baxter, F. S. (1951). *Recognition time for dial-type numerals as a function of size and brightness* (AF Technical Report 6465). Wright-Patterson AFB, OH: Wright Air Development Center.

Crook, M. N., & Baxter, F. S. (1954). *The design of digits* (WADC Technical Report 54-262). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 50 080)

Crook, M. N., Hanson, J. A., & Weisz, A. (1954). *Aeronautical charts under red light* (WADC Technical Report 54-198). Wright-Patterson AFB, OH: Wright Air Development Center.

Crook, M. N., Hanson, J. A., & Weisz, A. (1954). *Legibility of type as a function of stroke width, letter width, and letter spacing under low illumination* (WADC Technical Report 53-440). Wright-Patterson AFB, OH: Wright Air Development Center (DTIC No. 56 537)

Crook, M. N., Hanson, J. A., & Weisz, A. (1954). *Legibility of type as determined by the combined effect of typographical variables and reflectance of background* (WADC Technical Report 53-441). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 43 309)

Crook, M. N., Hanson, J. A., & Wulfeck, J. W. (1952). *The legibility of type as a function of reflectance of background under low illumination* (WADC Technical Report 52-85). Wright-Patterson AFB, OH: Wright Air Development Center.

Crook, M. N., Harker, G. S., Hoffman, A. C., & Kennedy, J. L. (1948). *Effect of vibration on legibility of tabular numerical material: Experiments 8 and 9* (AMC Memorandum Report MCREXD-694-1Q). Wright-Patterson AFB, OH: Air Materiel Command. (DTIC No. A950 047)

RELATIVE MOTION OF DIALS AND CONTROLS IN PURSUIT TRACKING
Measuring pilot performance in a pursuit tracking task with a crossed-pointer instrument used in some operational aircraft. The study determined the optimum direction of pointer motion relative to the movement of flight controls. The work was conducted by 1st Lt John F. Gardner. AF Technical Report No. 6016 (1950)

Crook, M. N., Harker, G. S., Hoffman, A. C., & Kennedy, J. L. (1950). *Effect of amplitude of apparent vibration, brightness, and type size on numeral reading* (AF Technical Report 6246). Wright-Patterson AFB, OH: Air Materiel Command.

Crook, M. N., Harker, G. S., Hoffman, A. C., Wulfeck, J. W., & Kennedy, J. L. (1949). *A determination of amplitude thresholds for the visual perception of vibration* (AMC Memorandum Report MCREXD-694-1R). Wright-Patterson AFB, OH: Air Materiel Command.

Crook, M. N., Hoffman, A. C., Wessell, N. Y., Wulfeck, J. W., & Kennedy, J. L. (1947). *Effect of vibration on legibility of tabular numerical material: Experiments 1 to 4* (AMC Memorandum Report TSEAA-694-1F). Wright-Patterson AFB, OH: Air Materiel Command.

Crook, M. N., Hoffman, A. C., Wessell, N. Y., Wulfeck, J. W., & Kennedy, J. L. (1947). *Effect of vibration on legibility of tabular numerical material: Experiments 5 to 7* (AMC Memorandum Report TSEAA-694-1K). Wright-Patterson AFB, OH: Air Materiel Command. (DTIC No. A950 046)

Daniels, G. S. (1952). *The "average man"?* (WCRD Technical Note 53-7). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 10 203)

Daniels, G. S., & Hertzberg, H. T. E. (1952). Applied anthropometry of the hand. *American Journal of Physical Anthropology, 10,* 209-215.

Daniels, G. S., Meyers, H. C., & Churchill, E. (1953). *Anthropometry of male basic trainees* (WADC Technical Report 53-49). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 20 717)

Daniels, G. S., Meyers, H. C., & Worrall, S. H. (1953). *Anthropometry of WAF basic trainees* (WADC Technical Report 53-12). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 20 943)

Danielson, L. E., Christensen, J. M., Bastian, W. R., & Ring, J. M. (1952). *Air weather service survey: II. Weather briefing* (AF Technical Report 6687(II)). Wright-Patterson AFB, OH: Wright Air Development Center.

Danielson, L. E., & Ring, J. M. (1952). *Air weather service study: IV. Critical incidents involving weather information* (AF Technical Report 6687(IV)). Wright-Patterson AFB, OH: Wright Air Development Center.

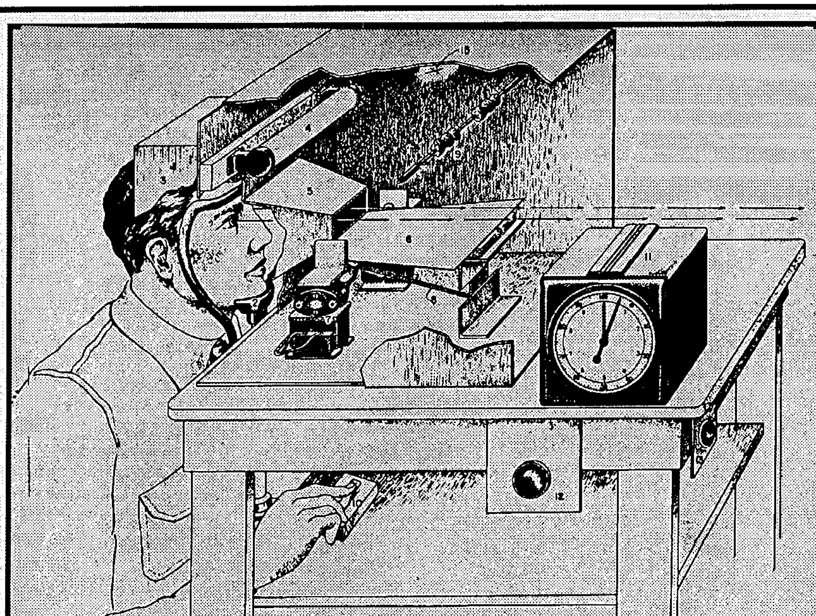
Danielson, L. E., Ring, J. M., & Bastian, W. R. (1952). *Air weather service survey: I. Forecaster and pilot opinions of organizational, personnel, and training procedures of the air weather service* (AF Technical Report 6687(I)). Wright-Patterson AFB, OH: Wright Air Development Center.

Danielson, L. E., Ring, J. M., & Bastian, W. R. (1952). *Air weather service survey: III. Weather station layout* (AF Technical Report 6687(III)). Wright-Patterson AFB, OH: Wright Air Development Center.

Day, W. F., & Beach, B. R. (1950). *A survey of the research literature comparing the visual and auditory presentation of information* (AF Technical Report 5921). Wright-Patterson AFB, OH: Air Materiel Command.

Deese, J. (1954). *Signal size and detectability on a PPI display* (WADC Technical Report 54-166). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 53 978)

Deese, J., & Ormond, E. (1953). *Studies of detectability during continuous visual search* (WADC Technical Report 53-8). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 24 214)



PAINTING AIRCRAFT FOR EASY VISIBILITY

Testing aircraft color markings for ease of detection to determine the most distinctive markings for operating in Arctic regions. The work was done by Capt Lawrence R. Wilcox and Dr. Walter F. Grether. AF Technical Report No. 5814 (1949)

Dempsey, C. A. (1953). *Development of a workspace measuring device* (WADC Technical Report 53-53). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 13 206)

Diamond, A. L., & Gilinsky, A. S. (1952). *Luminance thresholds for the resolution of visual detail during dark adaptation following different durations of light adaptation* (WADC Technical Report 52-257). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 7464)

Eckstrand, G. A., & Wickens, D. D. (1954). Transfer of perceptual set. *Journal of Experimental Psychology, 47,* 274-278.

Ellson, D. G. (1947). *The independence of tracking in two and three dimensions with the G. E. Pedestal Sign* (AMC Memorandum Report TSEAA-694-2G). Wright-Patterson AFB, OH: Air Materiel Command.

Ellson, D. G., & Coppock, H. (1961). *Further analysis of the psychological range effect* (AF Technical Report 6012). Wright-Patterson AFB, OH: Wright Air Development Center.

Ellson, D. G., & Gilbarg, D. (1948). *The application of operational analysis to human motor behavior* (AMC Memorandum Report MCREXD-694-2J). Wright-Patterson AFB, OH: Air Materiel Command.

Ellson, D. G., & Gray, F. E. (1948). *Frequency responses of human operators following a sine wave input* (AMC Memorandum Report MCREXD-694-2N). Wright-Patterson AFB, OH: Air Materiel Command.

Ellson, D. G., & Hill, H. (1947). *Action potentials during tracking* (AMC Memorandum Report TSEAA-694-2I). Wright-Patterson AFB, OH: Air Materiel Command.

Ellson, D. G., & Hill, H. (1947). *Wave length and amplitude characteristics of tracking error curves: II. Individual differences and learning effects* (AMC Memorandum Report TSEAA-694-2H). Wright-Patterson AFB, OH: Air Materiel Command.

Ellson, D. G., & Hill, H. (1948). *The interaction of responses to step function stimuli: I. Opposed steps of constant amplitude* (AMC Memorandum Report MCREXD-694-2P). Wright-Patterson AFB, OH: Air Materiel Command.

Ellson, D. G., Hill, H., & Craig, D. R. (1949). *The interaction of responses to step function stimuli: II. Equal opposed steps of varying amplitude* (AF Technical Report 5911). Wright-Patterson AFB, OH: Air Materiel Command.

Ellson, D. G., & Wheeler, L., Jr. (1949). *The range effect* (AF Technical Report 5813). Wright-Patterson AFB, OH: Air Materiel Command.

Ellson, D. G., & Wheeler, L., Jr. (1951). *Resonance in the human operator* (AF Technical Report 5834). Wright-Patterson AFB, OH: Wright Air Development Center.

As the Psychology Branch prospered, it also grew in size and in breadth of its responsibilities. Initially the branch had only three sections, one working on problems of visual displays, another on controls, and the third conducting flight research, first in a C-45, later in a C-47, and currently in a C-131 and two C-135 aircraft. In 1948, a new Systems Research Section was added, headed by Julien M. Christensen, now Chief of the Human Engineering Division. A Training Research Section was added in 1951, headed by Gordon A. Eckstrand. This has since grown into the Training Research Division. In the course of time other new activities were initiated which led to setting up new branches for "Maintenance Design" and "Environmental Stress."

— March 1965, "Human Engineering and Training Research Division," Behavioral Sciences Laboratory

Eriksen, C. W. (1954). *Multidimensional stimulus differences and accuracy of discrimination* (WADC Technical Report 54-165). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 50 076)

Eriksen, C. W. (1954). *Partitioning and saturation of the perceptual field and efficiency of visual search* (WADC Technical Report 54-161). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 40 730)

Fitts, P. M. (1946). German applied psychology during World War II. *The American Psychologist, 1*, 151-161.

Fitts, P. M. (1947). Psychological research on equipment design in the AAF. *The American Psychologist, 2*, 93-98.

Fitts, P. M. (1947). Psychology and aircraft design: A study of factors pertaining to safety. *Mechanical Engineering, 163*, 135-141.

Fitts, P. M. (1947). *Studies of visual discrimination time: The time required to recognize simple patterns at equal distances from the eye, and patterns at alternately far and near distances* (AMC Memorandum Report TSEAA-694-1H). Wright-Patterson AFB, OH: Air Materiel Command.

Fitts, P. M. (1949). *Psychological aspects of equipment design* (USAF Technical Report 5829). Wright-Patterson AFB, OH: Air Materiel Command.

Fitts, P. M., & Connell, S. C. (1949). *Psychological analysis of reports of unidentified aerial objects* (USAF Memorandum Report MCREXD-694-18D). Wright-Patterson AFB, OH: Air Materiel Command.

Fitts, P. M., & Jones, R. E. (1947). *Analysis of factors contributing to 460 "pilot-error" experiences in operating aircraft controls* (AMC Memorandum Report TSEAA-694-12). Wright-Patterson AFB, OH: Air Materiel Command.

Fitts, P. M., & Jones, R. E. (1947). *Psychological aspects of instrument display: I. Analysis of 270 "pilot-error" experiences in reading and interpreting aircraft instruments* (AMC Memorandum Report TSEAA-694-12A). Wright-Patterson AFB, OH: Air Materiel Command.

Fitts, P. M., Jones, R. E., & Milton, J. L. (1949). *Eye fixations of aircraft pilots: III. Frequency, duration, and sequence of fixations when flying Air Force Ground-Controlled Approach system (GCA)* (AF Technical Report 5967). Wright-Patterson AFB, OH: Air Materiel Command.

"One of the more unusual projects was flying in a wing-tip turret experiment. There was a pod out at the end of the wing on a B-17 where you sat throughout the flight. It was pretty frightening out there, with nothing but space on one side of you, and the realization that escape would be difficult, if not impossible. And of course, you always thought about the possibility that they would drag the wingtip on the landing. The data collected was mostly introspective—whether you could manipulate controls, whether the buffeting would be too severe, whether you would get sick. When I flew it was not particularly rough, but the wing still wobbled up and down a lot. I was in constant intercom contact, and if I had become sick, they probably would have aborted. Fortunately, that never happened. I don't think they ever pursued the concept of the wing-tip turret much beyond those early experiments."

"In a way, we initiated the area of man-machine dynamics modeling. With the publication of Wiener's book on cybernetics, Fitts interested one of the generals here on the base and the people at AFIT in the subject. Then I was sent to Europe to interview persons involved in the area over there. That was in 1947-48. I remember we sponsored the first seminars in man-machine dynamics, along with Frank Taylor of the University of Indiana. George Frost later wrote a nice summary of the area in the *Human Engineering Guide To Equipment Design*."

— Melvin Warrick, Associate Director Human Engineering Division

Fitts, P. M., & Seeger, C. M. (1953). S-R compatibility: Spatial characteristics of stimulus and response codes. *Journal of Experimental Psychology, 46*, 199-210.

Fitts, P. M., & Simon, C. W. (1952). *The arrangement of instruments, the distance between instruments, and the position of instrument pointers as determinants of performance in an eye-hand coordination task* (AF Technical Report 5832). Wright-Patterson AFB, OH: Wright Air Development Center.

Fitts, P. M., & Simon, C. W. (1952). Some relations between stimulus patterns and performance in a continuous dual-pursuit task. *Journal of Experimental Psychology, 43*, 428-436.

Ford, A., Olson, M. W., Rigler, D., Dugan, G. E., & Getz, M. H. (1950). *Single-operator signal tracking on ground radar* (AF Technical Report 6370). Wright-Patterson AFB, OH: Air Materiel Command.

Ford, A., Rigler, D., & Dugan, G. E. (1949). *Pantograph radar tracking: Point centering experiments* (USAF Technical Report 5969). Wright-Patterson AFB, OH: Air Materiel Command.

Ford, A., Rigler, D., & Dugan, G. E. (1950). Point centering of signals on an area. *Journal of Applied Psychology, 34*, 429-433.

Gardner, J. F. (1950). *Direction of pointer motion in relation to movement of flight controls: Cross-pointer type instrument* (AF Technical Report 6016). Wright-Patterson AFB, OH: Air Materiel Command.

Gardner, J. F. (1954). *Speed and accuracy of response to five different attitude indicators* (WADC Technical Report 54-236). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 63 456)

Gardner, J. F., & Lacey, R. J. (1954). *An experimental comparison of five different attitude indicators* (WADC Technical Report 54-32). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 34 642)

AN EARLY AIRCRAFT SIMULATOR
John F. Gardner serving as experimenter and Walter F. Grether serving as the subject in an aircraft simulator. Five different instruments are being compared for accuracy and reading speed. WADC-TR-54-236 (1954)

Garvey, W. D. (1953). The intelligibility of speeded speech. *Journal of Experimental Psychology, 45,* 102-108.

Garvey, W. D., & Henneman, R. H. (1950). *Practical limits of speeded speech* (AF Technical Report 5917). Wright-Patterson AFB, OH: Air Materiel Command.

Gilinsky, A. S. (1952). *A review of literature on the relative efficiency of the dominant and the nondominant eye* (WADC Technical Report 52-13). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 3567)

Gilinsky, A. S., & Brown, J. L. (1952). *Eye dominance and tracking performance* (WADC Technical Report 52-15). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 6460)

Gray, F. E., & Ellson, D. G. (1947). *Effects of friction and mode of operation upon accuracy of tracking with the G. E. Pedestal Sight* (AMC Memorandum Report TSEAA-694-2C). Wright-Patterson AFB, OH: Air Materiel Command.

Gray, F. E., & Ellson, D. G. (1947). *The validity of time-on-target (clock) scores as an estimate of tracking error magnitude* (AMC Memorandum Report TSEAA-694-2F). Wright-Patterson AFB, OH: Air Materiel Command.

Gray, F. E., Livingston, W. A., & Ellson, D. G. (1946). *Modifications of the AAF S.A.M. pedestal sight manipulation test* (AMC Memorandum Report TSEAA-694-2B). Wright-Patterson AFB, OH: Air Materiel Command.

Grether, W. F. (1945). Design of instrument dials for ease of reading. *S.A.E. Quarterly Transactions, 2,* 539-545.

Grether, W. F. (1946). *Design of clock dials for greatest speed and accuracy of reading in military (2400 hours) time system* (AMC Memorandum Report TSEAA-694-8). Wright-Patterson AFB, OH: Air Materiel Command.

Grether, W. F. (1946). *A study of several design factors influencing pilot efficiency in the operation of controls* (AMC Memorandum Report TSEAA-694-9). Wright-Patterson AFB, OH: Air Materiel Command.

Grether, W. F. (1947). *Design of aircraft switch panels for maximum ease of checking of switch position* (AMC Memorandum Report TSEAA-694-4F). Wright-Patterson AFB, OH: Air Materiel Command.

Grether, W. F. (1947). *Direction of control in relation to indicator movement in one-dimensional tracking* (AMC Memorandum Report TSEAA-694-4G). Wright-Patterson AFB, OH: Air Materiel Command.

Grether, W. F. (1947). *Discussion of pictorial versus symbolic aircraft instrument displays* (AMC Memorandum Report TSEAA-694-8B). Wright-Patterson AFB, OH: Air Materiel Command.

Grether, W. F. (1947). *The effect of variations in indicator design upon speed and accuracy of altitude readings* (AMC Memorandum Report TSEAA-694-14). Wright-Patterson AFB, OH: Air Materiel Command.

Grether, W. F. (1947). *Speed and accuracy of dial reading as a function of dial diameter and spacing of scale divisions* (AMC Memorandum Report TSEAA-694-1E). Wright-Patterson AFB, OH: Air Materiel Command.

Grether, W. F. (1948). *Analysis of types of errors in reading of the conventional three-pointer altimeter* (AMC Memorandum Report MCREXD-694-14A). Wright-Patterson AFB, OH: Air Materiel Command.

Grether, W. F. (1948). Designing instrument dials for quick, accurate reading. *Machine Design, 20,* 150-152.

Grether, W. F. (1948). Factors in the design of clock dials which affect speed and accuracy of reading in the 2400-hour time system. *Journal of Applied Psychology, 32,* 159-169.

Grether, W. F. (1949). Psychological factors in instrument reading: I. The design of long-scale indicators for speed and accuracy of quantitative readings. *Journal of Applied Psychology, 33,* 363-372.

Grether, W. F. (1950). *A dual compensatory pursuit apparatus for use in psychological research* (AF Technical Report 6036). Wright-Patterson AFB, OH: Air Materiel Command.

Grether, W. F. (1950). Obtaining readability in instrument dials. *Product Engineering, 21,* 109-112.

Grether, W. F. (1951). Can you read the altimeter? *Flying Safety, 7,* 10-12.

Grether, W. F., & Connell, S. C. (1948). *Psychological factors in check reading of single instrument* (AMC Memorandum Report MCREXD-694-17A). Wright-Patterson AFB, OH: Air Materiel Command.

Grether, W. F., Connell, S. C., & Bjornstad, J. M. (1949). *Experimental evaluation of the New London NAVY Lantern for testing color perception* (AMC Memorandum Report MCREXD-694-21B). Wright-Patterson AFB, OH: Air Materiel Command.

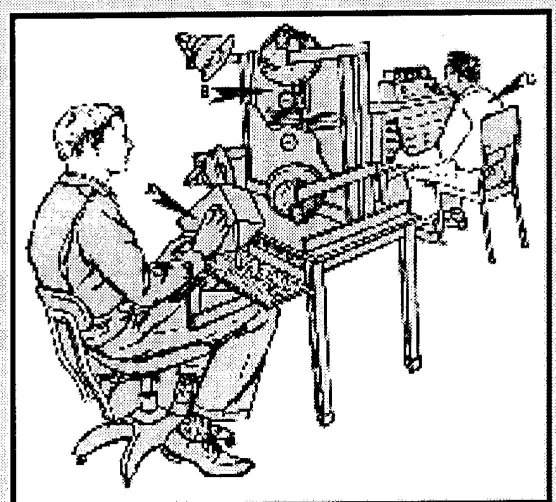
Grether, W. F., & Warrick, M. J. (1947). *Proposal for presenting localizer and glide path information to the pilot* (AMC Memorandum Report TSEAA-694-8A). Wright-Patterson AFB, OH: Air Materiel Command.

Grether, W. F., & Williams, A. C., Jr. (1949). Psychological factors in instrument reading: II. The accuracy of pointer position interpolation as a function of the distance between scale marks and illumination. *Journal of Applied Psychology, 33,* 594-604.

Hemphill, J. K., Matheny, W. G., & Walker, R. Y. (1947). *The evaluation of a psychomotor task for use in the study of warning signals* (AMC Memorandum Report TSEAA-694-8C). Wright-Patterson AFB, OH: Air Materiel Command. (DTIC No. 37 959)

Henneman, R. H., Lewis, P., & Matthews, T. L. (1953). *The influence of the sensory requirements of the distracting task: The first of a series of reports on auditory and visual message presentation under distracting task conditions* (WADC Technical Report 53-309). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 50 075)

Henneman, R. H., & Long, E. R. (1954). *A Comparison of the visual and auditory senses as channels for data presentation* (WADC Technical Report 54-363). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 61 558)



EFFECT OF DIAL SPACING IN PURSUIT TRACKING

Testing eye-hand coordination in a dual pursuit task in a study of the effects of arrangement of instrument pointers and the distance between them. The three experiments described in this report were conducted by Paul M. Fitts and Charles W. Simon. AF Technical Report No. 5832 (ATI No. 147788) (1952)

Thus it came about that in late August of 1945 a group of us assembled at the Aero Medical Laboratory and set about the task of planning a new research program in Human Engineering. It was characteristic of Paul that he had things well thought out in advance. He had studied the statistics on aircraft accidents, bombing errors, and other evidence of human failures attributed to poor design. He was familiar with the wartime work of a few psychologists in this country and in Great Britain dealing with equipment design problems. He had thought of approaches, such as field studies, to obtain a better understanding of research needs. He had also thought of many experiments that were just waiting to be done.

—Walter F. Grether, Chief
Psychology Branch, 1949-1956

Henneman, R. H., & Slivinske, A. J. (1949). *A message analysis of strategic air communication* (AF Technical Report 5918). Wright-Patterson AFB, OH: Air Materiel Command.

Hermans, T. G., Loucks, R. B., Checov, L., & Stern, F. (1947). *Annotated bibliography on the psychological aspects of orientation as they relate to aviation* (AMC Memorandum Report TSEAA-694-16A). Wright-Patterson AFB, OH: Air Materiel Command.

Herrick, R. M. (1954). *Foveal luminance discrimination as a function of the duration of the decrement or increment in luminance* (WADC Technical Report 54-463). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 51 051)

Herrick, R. M., Diamond, A. L., & Kuhns, M. P. (1952). *Luminance thresholds during dark adaptation following preadaptation to cathode ray tube displays* (WADC Technical Report 52-260). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 18 118)

Hertzberg, H. T. E. (1946). *Angular fields of view through the A-1 gunsight in the F-80 Cockpit modified for ejection* (AMC Memorandum Report TSEAA 695-73). Wright-Patterson AFB, OH: Air Materiel Command.

Hertzberg, H. T. E. (1947). *Contoured seat for the top of an experimental rigid dinghy box* (AMC Memorandum Report TSEAA-670-9). Wright-Patterson AFB, OH: Air Materiel Command.

Hertzberg, H. T. E. (1948). *Inhabited wing tip turret* (AMC Memorandum Report MCREXD-695-80). Wright-Patterson AFB, OH: Air Materiel Command.

Hertzberg, H. T. E. (1948). Post war anthropometry in the Air Force. *American Journal of Physical Anthropology, 6,* 363-371.

Hertzberg, H. T. E. (1949). *Comfort tests of the pulsating seat cushion and lumbar pad* (AMC Memorandum Report MCREXD-695-82). Wright-Patterson AFB, OH: Air Materiel Command. (DTIC No. 70 599)

Hertzberg, H. T. E. (1949). *Contoured seat for the top of an experimental rigid dinghy box* (AMC Memorandum Report MCREXD-670-9D, Report No. 2). Wright-Patterson AFB, OH: Air Materiel Command.

Hertzberg, H. T. E., & Colgan, J. W. (1948). *A prone position bed for pilots* (AMC Memorandum Report MCREXD-695-71D). Wright-Patterson AFB, OH: Air Materiel Command.

Hertzberg, H. T. E., & Daniels, G. S. (1949). *Hammock for the B-36 Airplane* (AMC Memorandum Report MCREXD-720-143). Wright-Patterson AFB, OH: Air Materiel Command.

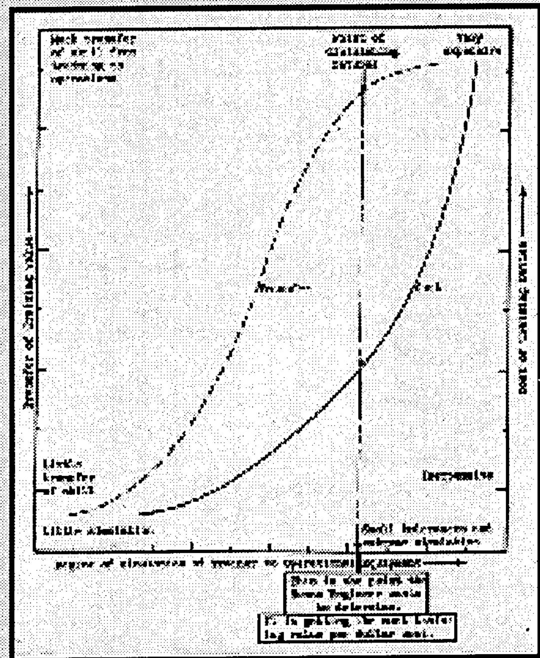
Hertzberg, H. T. E., & Daniels, G. S. (1950). *The center of gravity of a fully loaded F-86 ejection seat in the ejection position* (AMC Memorandum Report MCREXD-45341-4-5). Wright-Patterson AFB, OH: Air Materiel Command.

Hertzberg, H. T. E., & Daniels, G. S. (1952). Air Force anthropology in 1950. *American Journal of Physical Anthropology, 10,* 201-208.

Hertzberg, H. T. E., Daniels, G. S., & Churchill, E. (1954). *Anthropometry of flying personnel—1950* (WADC Technical Report 52-321). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 47 953)

Hill, H., & Ellson, D. G. (1947). *A review of muscle activity and action potentials as they are related to movement* (AMC Memorandum Report TSEAA-694-2E). Wright-Patterson AFB, OH: Air Materiel Command.

Hill, H., Gray, F., & Ellson, D. G. (1947). *Wave length and amplitude and characteristics of tracking error curves* (AMC Memorandum Report TSEAA-694-2D). Wright-Patterson AFB, OH: Air Materiel Command.



ENGINEERING SIMULATION AND TRAINING EQUIPMENT DESIGN

A graph of the relationship between degree of engineering simulation, cost, and value of transfer of training in training equipment design. This graph is from a handbook on training and training equipment design compiled by Robert B. Miller. WADC-TR-53-136 (1953)

Hixson, W. C., Harter, G. A., & Warren, C. E. (1954). *A radar simulator for use in air traffic control studies* (WADC Technical Report 53-418). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 33 463)

Hixson, W. C., Harter, G. A., Warren, C. E., & Cowan, J. D., Jr. (1954). *An electronic radar target simulator for air traffic control studies* (WADC Technical Report 54-569). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 95 405)

Horton, G. P. (1949). *Accuracy of reading target location and size of schematic PPI display* (AF Technical Report 5961). Wright-Patterson AFB, OH: Air Materiel Command.

Horton, G. P. (1949). *An analysis of errors made on a schematic PPI display* (USAF Technical Report 5960). Wright-Patterson AFB, OH: Air Materiel Command.

Horton, G. P. (1949). *Target shape and accuracy on a schematic PPI display* (USAF Technical Report 5962). Wright-Patterson AFB, OH: Air Materiel Command.

Houston, R. C., & Walker, R. Y. (1949). *The evaluation of auditory warning signals for aircraft* (AF Technical Report 5762). Wright-Patterson AFB, OH: Air Materiel Command.

Howe, R. M. (1954). *A study of the computer section of flight simulators* (University of Michigan Report 2164-6-F). Ann Arbor, MI: University of Michigan. (DTIC No. 60 155)

Howe, R. M., & Schetzer, J. D. (1954). *A study of the computer section of flight simulators* (University of Michigan Report 2164-1-F). Ann Arbor, MI: University of Michigan. (DTIC No. 64 527)

Howes, D. H. (1952). *Use of word-frequency tables in the preparation of labels* (WCRD Technical Memorandum Report 52-98). Wright-Patterson AFB, OH: Wright Air Development Center.

Howes, D. H. (1954). On the interpretation of word frequency as a variable affecting speed of recognition. *Journal of Experimental Psychology, 48*, 106-112.

Howes, D. H. (1954). *On the interpretation of word frequency as a variable affecting speed of recognition* (WADC Technical Report 54-282). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 43 066)

Howes, D. H. (1954). A statistical theory of the phenomenon of subception. *Psychological Review, 6l*, 98-110.

Hunt, D. P. (1953). *The coding of aircraft controls* (WADC Technical Report 53-221). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 20 796)

Hunt, D. P., & Craig, D. R. (1954). *The relative discriminability of thirty-one differently shaped knobs* (WADC Technical Report 54-108). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 63 503)

Hyman, R., & Hake, H. W. (1954). *Form recognition as a function of the number of forms which can be presented for recognition* (WADC Technical Report 54-164). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 50 568)

Imber, B. M., Stern, I. D., & Vanderplas, J. M. (1954). *Visual field restriction and apparent size of distant objects* (WADC Technical Report 54-23). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 27 682)

Jenkins, W. L. (1953). *Design factors in knobs and levers for making settings on scales and scopes* (WADC Technical Report 53-2). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 9724)

Jenkins, W. L., & Karr, A. C. (1954). The use of a joy stick in making settings on a simulated scope face. *Journal of Applied Psychology, 38*, 457-461.

Jenkins, W. L., Maas, L. O., & Olson, M. W. (1951). The influence of inertia in making settings on a linear scale. *Journal of Applied Psychology, 35*, 208-213.

Jenkins, W. L., Maas, L. O., & Rigler, D. (1950). Influence of friction in making settings on a linear scale. *Journal of Applied Psychology, 34*, 434-439.

Jenkins, W. L., & Olson, M. W. (1951). *The use of levers in making settings on a linear scale* (AF Technical Report 6563). Wright-Patterson AFB, OH: Wright Air Development Center.

Jenkins, W. O. (1946). *The accuracy of pilots and non-pilots in applying pressures on a control stick* (AMC Memorandum Report TSEAA-694-3). Wright-Patterson AFB, OH: Air Materiel Command.

Jenkins, W. O. (1946). *The accuracy of pilots in applying pressures on a wheel-type control* (AMC Memorandum Report TSEAA-694-3A). Wright-Patterson AFB, OH: Air Materiel Command.

Jenkins, W. O. (1946). *The accuracy of pilots in applying pressures on rudder pedals* (AMC Memorandum Report TSEAA-694-3B). Wright-Patterson AFB, OH: Air Materiel Command.

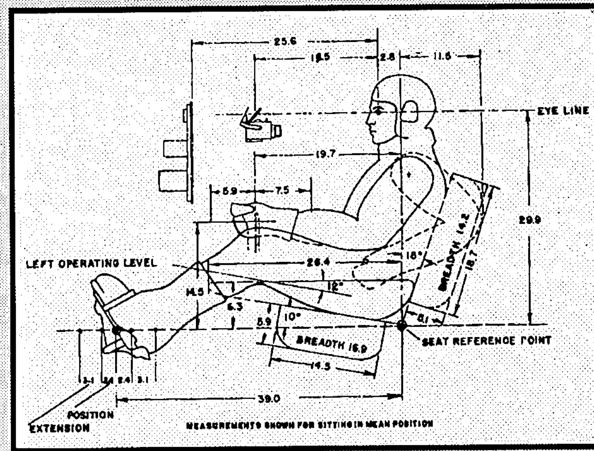
Jenkins, W. O. (1946). *A Follow-up investigation of shapes for use in coding aircraft control knobs* (AMC Memorandum Report TSEAA-694-4A). Wright-Patterson AFB, OH: Air Materiel Command. (DTIC No. 105 851)

Jenkins, W. O. (1946). *A further investigation of shapes for use in coding aircraft control knobs* (AMC Memorandum Report TSEAA-694-4B). Wright-Patterson AFB, OH: Air Materiel Command.

Jenkins, W. O. (1946). *Investigation of shapes for use in coding aircraft control knobs* (AMC Memorandum Report TSEAA-694-4). Wright-Patterson AFB, OH: Air Materiel Command.

Johnson, A. P. (1946). *Experimental comparison of sighting and triggering performance with hand grips as compared to hand wheel controls on the B-29 pedestal sight* (AMC Memorandum Report TSEAA-694-2). Wright-Patterson AFB, OH: Air Materiel Command.

Jones, R. E. (1947). *A survey of pilot preference regarding knob shapes to be used in coding aircraft controls* (AMC Memorandum Report TSEAA-694-4E). Wright-Patterson AFB, OH: Air Materiel Command.



BODY SIZE AND PERSONNEL EQUIPMENT

Normal measurements for the pilot's seat in fighter aircraft from a Human Factors Division handbook on human body size and personnel equipment in military aircraft. The handbook was compiled by Capt Francis E. Randall, Capt Albert Damon, Capt Robert S. Benton and 1st Lt Donald I. Patt. Report No. 5501, Army Air Force Material Command. (1946)

Fitts was an outstanding mechanic, and he knew how to design and, indeed, construct research apparatus of great delicacy and strength.

— Leonard Carmichael, Vice President for Research and Exploration, National Geographic Society, June 1965, "Paul M. Fitts Memorial Issue," Human Factors Society Bulletin

Walter F. Grether, PhD
Chief, Psychology Branch
1949 to 1956

In July 1945, Dr. Walter F. Grether, Major, US Army Air Force, joined Dr. Paul Fitts in establishing the Psychology Branch, Aero Medical Laboratory, Wright Field, Ohio.

Grether and Fitts attracted such greats from the US Army Air Force's Aviation Psychology Program as Judson Brown, Launor Carter, John Cowles, Glen Finch, and Albert Johnson (and briefly, Robert Gagne and Wilse Webb). Grether stayed with the branch and replaced Fitts as the branch chief in 1949, a position he held until 1956, when he became the civilian director of the Aero Medical Laboratory's newly formed Behavioral Sciences Division. This division encompassed both the Engineering Psychology Branch under Julien Christensen and the Training Research Branch under Gordon Eckstrand.

During his 11 years there, the Psychology Branch engaged in a broad range of pioneering research, including fatigue effects during long duration flights, pilot error caused by non-standard control and display arrangement and shape, poorly designed altitude displays, and feasibility of seating pilots in the prone position. Grether also performed original research, such as his study of human errors occurring as a result of reading the standard three-point altimeter. The study provided a solid basis for his conclusion that errors could be greatly reduced by adopting a single pointer display. This type of display is now standard in most aircraft.

Grether retired from civil service in 1975 and the USAF Reserves as a colonel in 1976.

Jones, R. E., Milton, J. L., & Fitts, P. M. (1947). *An investigation of errors made by pilots in judging the attitude of an aircraft without the aid of vision* (AMC Memorandum Report TSEAA-694-13). Wright-Patterson AFB, OH: Air Materiel Command.

Jones, R. E., Milton, J. L., & Fitts, P. M. (1949). *Eye fixations of aircraft pilots: I. A review of prior eye-movement studies and a description of a technique for recording the frequency, duration, and sequences of eye fixations during instrument flight* (USAF Technical Report 5837). Wright-Patterson AFB, OH: Air Materiel Command.

Jones, R. E., Milton, J. L., & Fitts, P. M. (1950). *Eye fixations of aircraft pilots: IV. Frequency, duration and sequence of fixations during routine instrument flight* (AF Technical Report 5975). Wright-Patterson AFB, OH: Air Materiel Command.

Kappauf, W. E. (1947). *The use of the angular transformation in the statistical treatment of error frequencies* (AMC Memorandum Report TSEAA-694-1J). Wright-Patterson AFB, OH: Air Materiel Command.

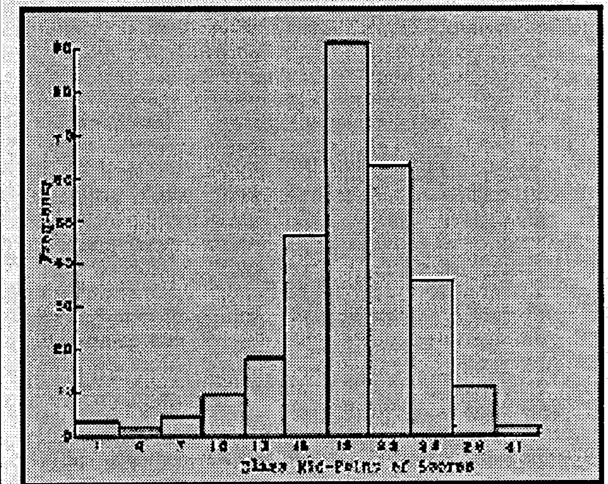
Kappauf, W. E. (1949). *Studies pertaining to the design of visual displays for aircraft instruments, computers, maps, charts, tables and graphs: A review of the literature* (AF Technical Report 5765). Wright-Patterson AFB, OH: Air Materiel Command.

Kappauf, W. E. (1951). *Design of instrument dials for maximum legibility: Part V. Origin location, scale break, number location, and contrast direction* (AF Technical Report 6366). Wright-Patterson AFB, OH: Wright Air Development Center.

Kappauf, W. E. (1951). *A discussion of scale-reading habits* (AF Technical Report 6569). Wright-Patterson AFB, OH: Wright Air Development Center.

Kappauf, W. E. (1951). *Some data on the influence of attempted interpolation on the speed and errors of scale readings* (AF Technical Report 6530). Wright-Patterson AFB, OH: Wright Air Development Center.

Kappauf, W. E., & Smith, W. M. (1948). *Design of instrument dials for maximum legibility: II. A preliminary experiment on dial size and graduation* (AMC Memorandum Report MCREXD-694-1N). Wright-Patterson AFB, OH: Air Materiel Command.



ASSOCIATING CLOUD TYPES WITH FLYING HAZARDS

Investigating the ability of pilots to associate flying hazards with cloud types. This work, part of an Air Weather Service Survey to help develop adequate weather briefings for pilots, was done by Lee E. Danielson, Julien M. Christensen, William R. Bastian, and Jean M. Ring. AF Technical Report 6687, Part 2 (1952)

Kappauf, W. E., & Smith, W. M. (1950). *Design of instrument dials for maximum legibility: II. Some data on the difficulty of quantitative reading in different parts of a dial* (AF Technical Report 5914(III)). Wright-Patterson AFB, OH: Air Materiel Command.

Kappauf, W. E., & Smith, W. M. (1950). *Design of instrument dials for maximum legibility: IV. Dial graduation, scale range, and dial size as factors affecting the speed and accuracy of scale reading* (AF Technical Report 5914(IV)). Wright-Patterson AFB, OH: Air Materiel Command.

Kay, M. E., & Christensen, J. M. (1950). *Inspection of the Goodyear Plotting Board* (AMC Memorandum Report MCREXD-694-2A). Wright-Patterson AFB, OH: Air Materiel Command.

Kraft, C. L., & Fitts, P. M. (1954). *A broad-band blue lighting system for radar air traffic control centers* (WADC Technical Report 53-416). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 37 701)

Kreezer, G. L., Hill, J. H., & Manning, W. (1954). *Attention: A bibliography and classification of the psychological literature* (WADC Technical Report 54-455). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 57 821)

Krendel, E. S. (1951). *A preliminary study of the power-spectrum approach to the analysis of perceptual-motor performance* (AF Technical Report 6723). Wright-Patterson AFB, OH: Wright Air Development Center.

Krendel, E. S. (1952). *The spectral density study of tracking performance: I. The effect of instructions* (WADC Technical Report 52-11(I)). Wright-Patterson AFB, OH: Wright Air Development Center.

Krendel, E. S. (1952). *The spectral density study of tracking performance: II. The effects of input amplitude and practice* (WADC Technical Report 52-11(II)). Wright-Patterson AFB, OH: Wright Air Development Center.

Krendel, E. S., & Barnes, G. H. (1954). *Interim report on human frequency response studies* (WADC Technical Report 54-370). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 47 529)

Lacey, R. J. (1954). *Suitability of the gray instrument panel for use in USAF aircraft* (WCRD Technical Note 54-12). Wright-Patterson AFB, OH: Wright Air Development Center.

Leibowitz, H. W. (1953). *Visual factors influencing the precision of adjustment of reticle patterns: The influence of luminance, test object orientation, and test object-luminance relationship on vernier adjustments* (WADC TR 53-200). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 18 704)

Leibowitz, H. W., & Kaestner, N. (1954). *The effect of exposure time, individual variability, and practice on the precision of vernier adjustments* (WADC Technical Report 54-77). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 45 693)

Leibowitz, H. W., & Lomont, J. F. (1954). *The effect of grid lines in the field of view upon perception of motion: One of a series of reports on perception of motion* (WADC Technical Report 54-201). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 38 210)

Leibowitz, H. W., & Lomont, J. F. (1954). *The effect of luminance and exposure time upon perception of motion: One of a series of reports on perception of motion* (WADC Technical Report 54-78). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 35 163)

Levine, M. (1953). *Tracking performance as a function of exponential delay between control and display* (WADC Technical Report 53-236). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 26 450)

Long, E. R., & Garvey, W. D. (1953). *The role of setting cues in reducing the simultaneous location and identification ambiguity of letter patterns: The fifth of a series of reports on "set" as a determiner of perceptual responses* (WADC Technical Report 53-311). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 34 517)

Long, E. R., Henneman, R. H., & Reid, L. S. (1953). *Theoretical considerations and exploratory investigation of "set" as response restriction: The first of a series of reports on "set" as a determiner of perceptual responses* (WADC Technical Report 53-311). Wright-Patterson AFB, OH: Wright Air Development Center.

Long, E. R., & Lee, W. A. (1953). *The influence of specific stimulus cuing on location responses: The third of a series of reports on "set" as a determiner of perceptual responses* (WADC Technical Report 53-314). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 34 520)

Long, E. R., & Lee, W. A. (1953). *The role of spatial cuing as a response-limiter for location responses: The second of a series of reports on "set" as a determiner of perceptual responses* (WADC Technical Report 53-312). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 34 516)

Long, E. R., & Reid, L. S. (1952). *Factors determining the legibility of letters and words printed in "dot" patterns with differential brightnesses of the patterns proportional to the amount of degradation: The second of a series of reports on the "infomax" principle* (AF Technical Report 5923). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 1145)

29 May 1945...directive to the Commanding General, Air Technical Service Command, Wright Field, Dayton, Ohio . . . stating: "It is desired that facilities be established for conducting scientific psychological research on problems of aviation equipment. Because of the intimate relationship between psychological, medical, physiological and biophysical research problems, it is believed that this psychological research project should be established as a branch of the Aero Medical Laboratory."

— Air Staff Directive

Long, E. R., & Reid, L. S. (1952). *Factors determining the legibility of letters and words printed in "dot" patterns with pure black and white when the patterns are degraded in varying amounts: The first of a series of reports on the "infomax" principle* (AF Technical Report 5922). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 1144)

Long, E. R., Reid, L. S., & Garvey, W. D. (1954). *The role of stimulus ambiguity and degree of response restriction in the recognition of distorted letter patterns: The fourth of a series of reports on "set" as a determiner of perceptual responses* (WADC Technical Report 54-147). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 48 906)

Long, E. R., Reid, L. S., & Queal, R. W. (1951). *Factors determining the legibility of letters and words derived from elemental printers: The third of a series of reports on the "infomax" principle* (AF Technical Report 5924). Wright-Patterson AFB, OH: Wright Air Development Center.

Long, G. E. (1948). *Engineering psychology service: I.* (AMC Memorandum Report MCREXD-694-18A). Wright-Patterson AFB, OH: Air Materiel Command.

Long, G. E. (1949). *Speed and accuracy of readings as a function of design in the sensitive airspeed indicator* (USAF Technical Report 5836). Wright-Patterson AFB, OH: Air Materiel Command.

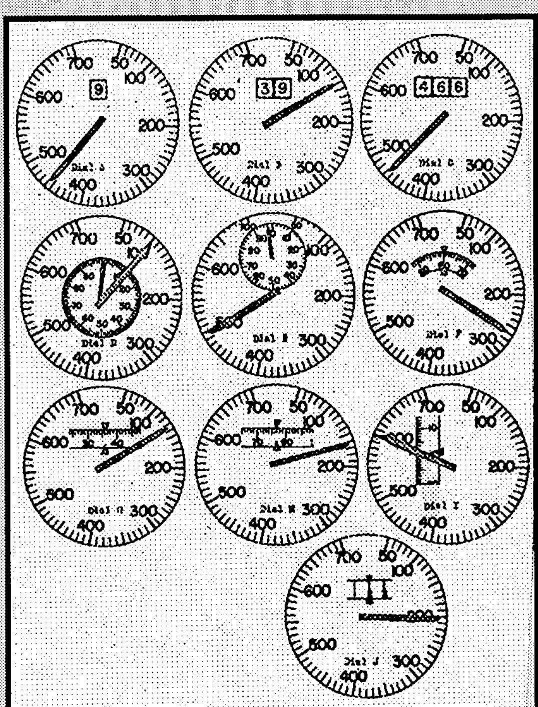
Long, G. E., & Fitts, P. M. (1949). *Human engineering aspects of the Berlin Airlift* (AMC Memorandum Report MCREXD-694-23). Wright-Patterson AFB, OH: Air Materiel Command.

Loucks, R. B. (1947). *An azimuth trainer for evaluating the interpretability of directional indicating flight instruments* (AMC Memorandum Report TSEAA-694-16). Wright-Patterson AFB, OH: Air Materiel Command.

Loucks, R. B. (1949). *An analysis of the types of errors made by novices in interpreting azimuth indicators when the bearings are administered verbally* (USAF Technical Report 5958). Wright-Patterson AFB, OH: Air Materiel Command.

Loucks, R. B. (1949). *An experimental comparison of the relative effectiveness with which two types of map reading procedures can be utilized by novices* (USAF Technical Report 5963). Wright-Patterson AFB, OH: Air Materiel Command.

Loucks, R. B. (1949). *An experimental study of the effectiveness with which novices can interpret a localizer-glidepath approach indicator* (USAF Technical Report 5959). Wright-Patterson AFB, OH: Air Materiel Command.



DESIGNING AIRSPEED INDICATORS FOR READING SPEED AND ACCURACY

Airspeed indicators used in a study comparing reading speed and accuracy to determine the best design for these instruments. The work was done by Maj George E. Long. USAF Technical Report No. 5836 (1949)

Loucks, R. B. (1949). *High-speed graphic sweep recorders derived from the keinath scanning technique* (USAF Technical Report 5964). Wright-Patterson AFB, OH: Air Materiel Command.

Loucks, R. B. (1949). *Interpretation of azimuth indicators by novices: I. Aircraft direction indicators with fixed lubber lines and azimuth cards that turn* (AF Technical Report 5957). Wright-Patterson AFB, OH: Air Materiel Command.

Loucks, R. B. (1950). *The interpretation of azimuth indicators by novices: II. Aircraft indicators with full-scale azimuth cards that turn* (AF Technical Report 5965). Wright-Patterson AFB, OH: Air Materiel Command.

McGehee, C. R., Sabeh, R., & Chiles, W. D. (1953). *Operator fatigue and fighter range extension* (WADC Technical Report 53-380). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 29 591)

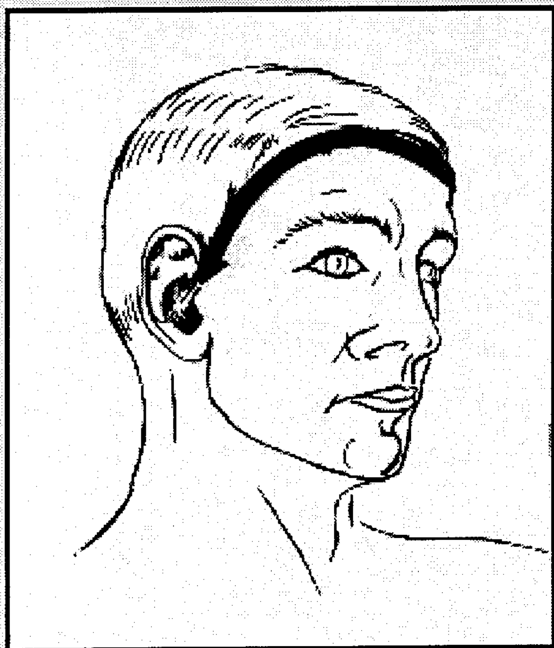
McGuire, J. C. (1954). *Apparatus for presentation and continuous measurement of error in a two-dimensional compensatory tracking task* (WADC Technical Report 54-335). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 57 389)

McGuire, J. C. (1954). *The effect of target velocity and the area of error-tolerance circles upon performance in a two-dimensional compensatory tracking task* (WADC Technical Report 54-431). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 99 642)

McIntosh, B. B., Milton, J. L., & Cole, E. L. (1952). *Pilot performance during extended periods of instrument flight* (AF Technical Report 6725). Wright-Patterson AFB, OH: Wright Air Development Center.

Miller, R. B. (1953). *Handbook on training and training equipment design* (WADC Technical Report 53-136). Wright-Patterson AFB, OH: Wright Air Development Center.

Milton, J. L. (1946). *An experimental comparison of the accuracy of tracking, ranging and triggering with two new-type gunsight hand controls* (AMC Memorandum Report TSEAA-694-2A). Wright-Patterson AFB, OH: Air Materiel Command.



HEAD DIMENSIONS FROM NOMOGRAMS
The bitragion-crinon arc head dimension was one of 12 head size measures in a study that provided two nomograms for determining the most accurate estimate of each of the dimensions based on known values of head length, breadth and circumference. Study completed by Edmund Churchill of Antioch College and Gilbert S. Daniels. WADC-TR-53-14 (1953)

Milton, J. L., Jones, R. E., & Fitts, P. M. (1949). *Eye fixations of aircraft pilots: II. Frequency, duration, and sequence of fixations when flying the USAF Instrument Low Approach System (ILAS)* (AF Technical Report 5839). Wright-Patterson AFB, OH: Air Materiel Command.

Milton, J. L., Jones, R. E., & Fitts, P. M. (1950). *Eye fixations of aircraft pilots: V. Frequency, duration, and sequence of fixations when flying selected maneuvers during instrument and visual flight conditions* (AF Technical Report 6018). Wright-Patterson AFB, OH: Air Materiel Command.

Milton, J. L., Jones, R. E., Morris, J. B., & Fitts, P. M. (1947). *Pilot reaction time: The time required to comprehend and react to contact and instrument recovery problems* (AMC Memorandum Report TSEAA-694-13A). Wright-Patterson AFB, OH: Air Materiel Command.

Milton, J. L., McIntosh, B. B., & Cole, E. L. (1951). Eye fixations of aircraft pilots: VI. Fixations during day and night ILAS approaches using an experimental instrument panel arrangement (AF Technical Report 6570). Wright-Patterson AFB, OH: Wright Air Development Center.

Milton, J. L., McIntosh, B. B., & Cole, E. L. (1952). *Fixations during day and night GCA approaches using an experimental instrument panel arrangement: The seventh of a series of reports on eye fixations of aircraft pilots* (AF Technical Report 6709). Wright-Patterson AFB, OH: Wright Air Development Center.

Milton, J. L., & Wolfe, F. J. (1952). *Fixations during zero-reader approaches in a jet aircraft: The eighth of a series of reports on eye fixations of aircraft pilots* (WADC Technical Report 52-17). Wright-Patterson AFB, OH: Wright Air Development Center.

Morin, R. E., & Grant, D. A. (1953). *Spatial stimulus-response correspondence: Performance on a key-pressing task as a function of the degree of spatial stimulus-response correspondence* (WADC Technical Report 53-292). Wright-Patterson AFB, OH: Wright Air Development Center.

Morin, R. E., Grant, D. A., & Nystrom, C. O. (1954). *Temporal predictions of motion inferred from intermittently viewed light stimuli* (WADC Technical Report 54-69). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 37 703)

Morrison, N., & Shafer, L. (1954). *Ground study of the nonejection methods of escape from B-47B Aircraft* (WADC Technical Report 54-6). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 30 282)

Mote, F. A., Biersdorf, W. R., Kent, G. W., & Myers, J. (1954). *Visual contrast discrimination as a function of pre-exposure to light* (WADC Technical Report 54-80). Wright-Patterson AFB, OH: Wright Air Development Center. (No. 33 356)

Narasimhan, R., & Benepe, O. J. (1951). *The use of autocorrelation functions in the harmonic analysis of human behavior* (AF Technical Report 6529). Wright-Patterson AFB, OH: Wright Air Development Center.

Nystrom, C. O., & Grant, D. A. (1954). *Performance on a key pressing task as a function of the angular correspondence between stimulus and response elements* (WADC Technical Report 54-71). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 35 130)

O'Brien, B. (1953). *A study of night myopia* (WADC Technical Report 53-206). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 19 807)

O'Brien, B., & Miller, N. D. (1953). *A study of the mechanism of visual acuity in the central retina* (WADC Technical Report 53-198). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 23 895)

Patt, D. (1946). *Principles of cockpit seating* (AMC Memorandum Report TSEAA-695-58C). Wright-Patterson AFB, OH: Air Technical Service Command. (DTIC No. 50 569)

Peterson, J. W. (1954). *Differential analyzer solution of the linearized F-86D Equations* (University of Michigan Report 2164-4-T). Ann Arbor, MI: University of Michigan. (DTIC No. 87 032)

Pigg, L. D. (1954). *Orientation of controls in bilateral transfer of training* (WADC Technical Report 54-376). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 63 505)

Although engineering psychology had its birth during World War II, the level of research effort in the United States was on a modest scale until after the end of the hostilities in August 1945. This low level of effort was apparently deliberate, because it was recognized that only during a prolonged conflict could the benefits of such research be realized. Obviously, the time lag between initiation of engineering psychology research and the design, manufacture, and deployment of new or redesigned equipment is relatively long, often five years or more. Thus, during wartime, it was more profitable for psychologists to concentrate on other types of research, such as selection and training, with faster payoff.

—W.F. Grether, 1968, "Engineering Psychology in the United States," American Psychologist

Paul most certainly was among those engineers and scientists who served to give initial impetus and direction to an infant, interdisciplinary "human factors" area of endeavor. But without the wisdom, diligence, and dedication supplied by Dr. Fitts, human factors might not have survived its infant years.

— G.F. Rabideau, Editor, June 1965, "Paul M. Fitts Memorial Issue," Human Factors Society Bulletin

Queal, R. W., Jr. (1954). *Experimental component arrangement for the radar air traffic control center* (WCRD Technical Note 53-142). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 126 083)

Randall, F. E., Damon, A., Benton, R. S., & Patt, D. I. (1946). *Human body size in military aircraft and personal equipment* (AAF Technical Report 5501). Wright Field, OH: Air Materiel Command.

Ranken, H. B. (1952). *Determination of width and luminance of a cathode-ray-tube trace* (WADC Technical Report 52-258). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 12 018)

Reid, L. S., & Holland, J. G. (1954). *The influence of stimulus similarity and stimulus rate: The third of a series of reports on experimental analysis of complex task performance* (WADC Technical Report 54-146). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 49 630)

Reid, L. S., & Slivinske, A. J. (1953). *Rationale, experimental methodology, and exploratory investigation: The first of a series of reports on experimental analysis of complex task performance* (WADC Technical Report 53-310). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 33 355)

Ring, J. M., & Christensen, J. M. (1950). *An objective evaluation of two Air Force navigation plotters* (AF Technical Report 5971). Wright-Patterson AFB, OH: Air Materiel Command.

Rock, M. L. (1949). *Annotated bibliography on visual performance at low photopic illumination levels* (AF Technical Report 5822). Wright-Patterson AFB, OH: Air Materiel Command.

"I was discharged from the US Army Air Force here at Wright-Patterson in March 1946. I had been working with the Aviation Psychology program while in the military. When I came on board Walt Grether was the Psychology Branch Chief and Julien Christensen was there, still in uniform. The actual staff at that time was just a handful of people. I had not known Paul Fitts, strangely enough, but he had been in Washington and, of course, knew about me. Chris and I had worked for the so-called "Trade Test" division—which was part of the Adjutant General's Office—on the problem of selecting aircrew and ground crew personnel. Chris was assigned here in uniform, and I had originally come here just to be discharged. But because the branch was here, and the work appealed to me, I stayed.

***

"My first project was the population stereotype for stimulus-response compatibility studies. Later, other people named parts of the results "Warrick's Law." I did the basic research then and Chris worked on applied problems."

***

"One of the more memorable people I worked with was Bill Biel. He came here after the war as my boss. He was most inspirational, protective, and friendly; the friendship continues to this day."

— Melvin Warrick, Associate Director Human Engineering Division

Rock, M. L. (1953). Visual performance as a function of low photopic brightness levels. *Journal of Applied Psychology, 37,* 412-427.

Rockway, M. R. (1954). *The effect of variations in control-display ratio and exponential time delay on tracking performance* (WADC Technical Report 54-618). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 62763)

Rulon, P. J., Sampson, P. B., & Schohan, B. (1951). *The effects of "G" forces on the performance of teletype operators* (AF Technical Report 6568). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 1164)

Schapiro, H. B. (1952). *Factors affecting legibility of digits* (WADC Technical Report 52-127). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 1117)

Senders, J. W. (1953). *The influence of surround on tracking performance: I. Tracking on combined pursuit and compensatory one-dimensional tasks with and without a structured surround* (WADC Technical Report 52-229). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 12 618)

Senders, J. W., & Cruzen, M. (1952). *Tracking performance on combined compensatory and pursuit tasks* (WADC Technical Report 52-39). Wright-Patterson AFB, OH: Wright Air Development Center.

Senders, V. L. (1952). *The effect of number of dials on qualitative reading of a multiple dial panel* (WADC Technical Report 52-182). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 6632)

Senders, V. L., & Cohen, J. (1953). *The influence of methodology on research on instrument displays* (WADC Technical Report 53-93). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 16 747)

Senders, V. L., & Cohen, J. (1954). *The effects of absolute and conditional probability distributions of instrument settings on scale readings: Repeated exposures of the same setting* (WADC Technical Report 54-253). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 54 628)

Senders, V. L., & Sowards, A. (1952). Analysis of response sequences in the setting of a psychophysical experiment. *The American Journal of Psychology, 65,* 358-374.

Simon, C. W. (1952). *Instrument-control configurations affecting performance in a compensatory pursuit task* (AF Technical Report 6015). Wright-Patterson AFB, OH: Wright Air Development Center.

Simon, C. W. (1954). *Effects of stress on performance in a dominant and a non-dominant task* (WADC Technical Report 54-285). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 53 977)

Simon, C. W. (1954). *The presence of a dual perceptual set for certain perceptual-motor tasks* (WADC Technical Report 54-286). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 52 500)

Slivinske, A. J. (1953). *The factors of task complexity and previous practice on a patterned component: The second of a series of reports on experimental analysis of complex task performance* (WADC Technical Report 53-313). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 33 354)

Smith, B. J. (1952). *Flight evaluation of experimental radar scopes in terms of bombing accuracy and radar observers preferences* (USAF Memorandum Report WCRDP-694-26). Wright-Patterson AFB, OH: Wright Air Development Center.

Smith, B. J., & Christensen, J. M. (1951). *Inspection of the radar bombardier and navigator positions in Project Reliable Aircraft Number 651* (Memorandum Report WCRDP-694-25). Wright-Patterson AFB, OH: Wright Air Development Center.

Smith, W. M., & Kappauf, W. E. (1947). *Studies pertaining to the design and use of visual displays for aircraft instruments, computers, maps, charts and tables: A bibliography* (AMC Memorandum Report TSEAA-694-1G). Wright-Patterson AFB, OH: Air Materiel Command.

Smithson, J. E. (1954). *Power spectral densities of aircraft deviations from a heading* (WCRD 54-16). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 58 435)

Spragg, S. D. S., & Kanwisher, J. (1952). *The effects of brightness and color of illumination on performance of a complex perceptual-motor task (flying a link trainer)* (WADC Technical Report 52-203). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 126)

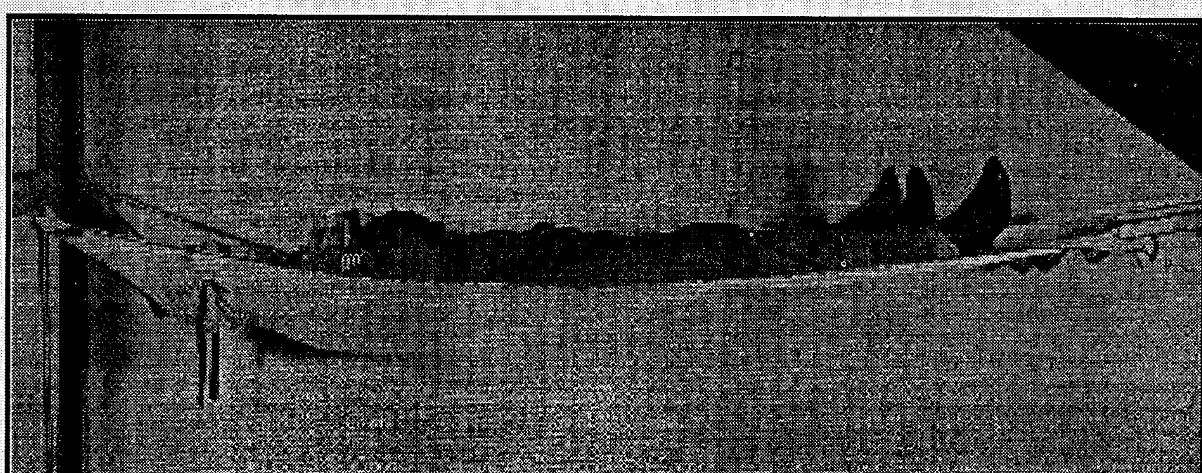
Spragg, S. D. S., & Rock, M. L. (1948). *Dial reading performance as related to illumination variables: I. Intensity* (AMC Memorandum Report MCREXD-694-21). Wright-Patterson AFB, OH: Air Materiel Command.

Spragg, S. D. S., & Rock, M. L. (1948). *Dial reading performance as related to illumination variables: II. Spectral distribution* (AMC Memorandum Report MCREXD-694-21A). Wright-Patterson AFB, OH: Air Materiel Command.

Spragg, S. D. S., & Rock, M. L. (1950). *Dial reading performance as related to illumination variables: III. Results with small dials* (AF Technical Report 6040). Wright-Patterson AFB, OH: Air Materiel Command.

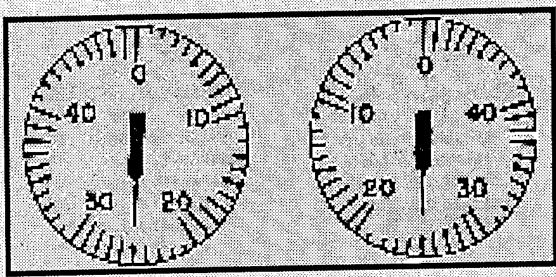
Spragg, S. D. S., & Rock, M. L. (1952). Dial reading performance as a function of brightness. *Journal of Applied Psychology, 36*, 128-137.

Spragg, S. D. S., & Rock, M. L. (1952). Dial reading performance as a function of color of illumination. *Journal of Applied Psychology, 36*, 196-200.



DESIGNING A HAMMOCK FOR BOMBER CREWS

A hammock for the B-36 aircraft designed with anthropometric data for Air Force crew members. The report contains detailed instructions for placing and installing the hammock. The work was done by H.T.E. Hertzberg and Gilbert S. Daniels. Memorandum report MCREXD-720-143 (ATI 122 733)(1949)



DIAL READING ACCURACY

Examples of staircase instrument scales used in a study of their effects on dial reading accuracy. The investigation was done because pilots were making dial reading reversal errors in reading a navigation plotter. The work was done by Julien M. Christensen. Memorandum report MCREXD-694-1-P (1948)

Spragg, S. D. S., & Wulfeck, J. W. (1953). *Visual performance as a function of the brightness of an immediately preceding visual task* (WADC Technical Report 52-285). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 27 599)

Stump, N. E. (1952). *Toggle switches - activation time as a function of spring tension* (WCRD Technical Note 52-39). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 61 598)

Stump, N. E. (1952). *Toggle switches - activation time as a function of the plane of orientation and the direction of movement* (WCRD Technical Note 52-51). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 12 170)

Stump, N. E. (1953). *Manipulability of rotary controls as a function of knob diameter and control orientation* (WCRD Technical Note 53-12). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 7500)

Teichner, W. H. (1952). *The simple reaction time, a review with reference to Air Force equipment* (WCRD Technical Note 52-47). Wright-Patterson AFB, OH: Wright Air Development Center.

Travis, R. C. (1948). Measurement of accommodations and convergence time as part of a complex visual adjustment. *Journal of Experimental Psychology, 38*, 395-403.

Van Saun, H. R. (1946). *The comparative interpretability of two methods of presented bombing information by radar* (AMC Memorandum Report TSEAA-694-5). Wright-Patterson AFB, OH: Air Materiel Command

Van Saun, H. R. (1946). *Duties of aircrew members in the nose position of a very heavy bombardment airplane during a typical mission* (AMC Memorandum Report TSEAA-694-4D). Wright-Patterson AFB, OH: Air Materiel Command..

Vanderplas, J. M. (1952). *Flight evaluation of experimental 10 inch radar cathode ray tubes in terms of operator preference* (WCRD Technical Memorandum Report 52-55). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 55 666)

Vanderplas, J. M. (1952). *Radar operator visual fatigue: A summary of available evidence and some preliminary suggestions for the reduction of visual fatigue* (WCRD Technical Note 52-44). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 62 112)

Vanderplas, J. M. (1953). Frequency of experience versus organization as determinants of visual thresholds. *American Journal of Psychology, 66*, 574-583.

Vanderplas, J. M. (1953). *Interior color schemes for aircraft gray instrument panel* (WCRD Technical Note 53-71). Wright-Patterson AFB, OH: Wright Air Development Center.

Vanderplas, J. M. (1954). *The apparent size of objects viewed through telescopes* (WADC Technical Report 54-459). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 75 792)

"Many of Lt Col Fitts' early experiments dealt with the design of air crew stations...The controls and displays in WWII airplanes were similar in shape, design, and location. If a flight member mistakenly grabbed the wrong control, an aircraft accident or bombing error could result."

—C. Bates, May 1985
"Human Engineering, Yesterday and Today," Civilian Employees Reporter

Vanderplas, J. M. (1954). *Some perceptual factors involved in the design of obstacle warning displays for aircraft* (WCRD Technical Note 54-9). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 65 872)

Warren, C. E., Fitts, P. M., & Clark, J. R. (1952). An electronic apparatus for the study of the human operator in a one-dimensional closed-loop continuous pursuit task. *AIEE Transactions, 71.*

Warrick, M. J. (1947). *Direction of movement in the use of control knobs to position visual indicators* (AMC Memorandum Report TSEAA-694-4C). Wright-Patterson AFB, OH: Air Materiel Command.

Warrick, M. J. (1948). *Conference with Dr. John R. Ragazzini on servo-analysis as applied to responses of human operators* (USAF Memorandum Report MCREXD-694-2K). Wright-Patterson AFB, OH: Air Materiel Command.

Warrick, M. J. (1948). *Direction of motion stereotypes in positioning a visual indicator by use of a control knob: II. Results from a printed test* (AMC Memorandum Report MCREXD-694-19A). Wright-Patterson AFB, OH: Air Materiel Command.

Warrick, M. J. (1948). *Report of visit to selected psychological facilities of the United Kingdom* (USAF Memorandum Report MCREXD-694-18). Wright-Patterson AFB, OH: Air Materiel Command.

Warrick, M. J. (1949). *Effect of transmission-type control lags on tracking accuracy* (USAF Technical Report 5916). Wright-Patterson AFB, OH: Air Materiel Command.

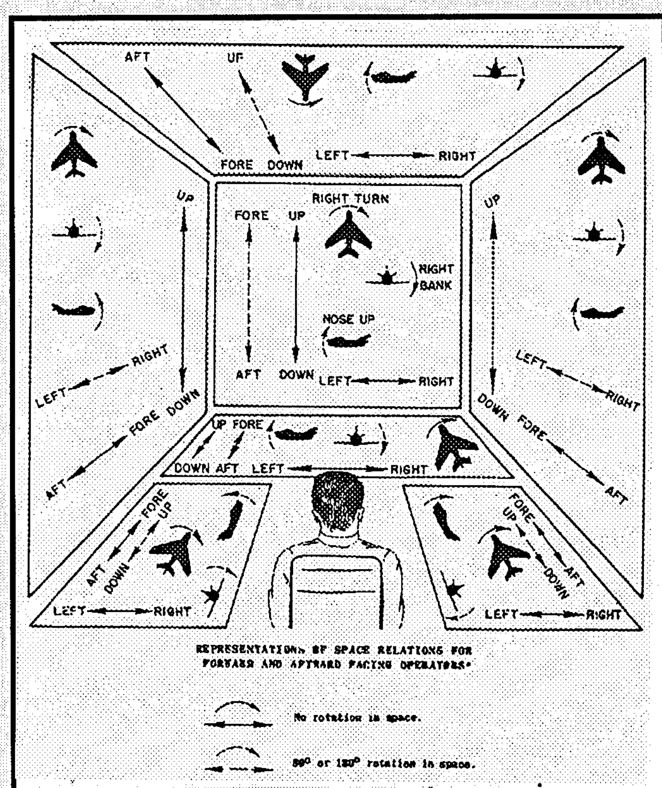
Warrick, M. J. (1949). *Effects of motion relationships on speed of positioning visual indicators by rotary control knobs* (AF Technical Report 5812). Wright-Patterson AFB, OH: Air Materiel Command.

Warrick, M. J. (1952). *Design and use of counters for airborne equipment* (WCRD Technical Note 52-80). Wright-Patterson AFB, OH: Wright Air Development Center.

Warrick, M. J. (1954). *Counters for airborne use* (WADC Technical Report 54-266). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 45 991)

Warrick, M. J., & Grether, W. F. (1948). *The effect of pointer alignment on check reading of engine instrument panels* (AMC Memorandum Report MCREXD-694-17). Wright-Patterson AFB, OH: Air Materiel Command.

Warrick, M. J., & Lund, D. W. (1946). *Effect of moderate positive acceleration (G) on ability to read aircraft-type instrument dials* (AMC Memorandum Report TSEAA-694-10). Wright-Patterson AFB, OH: Air Materiel Command.



VISUAL PRESENTATION OF INFORMATION
Instrument panel layout representations for forward- and rearward-facing operators from a report on the visual presentation of information prepared under Research and Development Project Number 7180, Human Engineering Applications to Equipment Design. The authors were Charles A. Baker and Walter F. Grether. WADC-TR-54-160 (1954)

White, B. C., Johnson, P. J., & Hertzberg, H. T. E. (1952). *Review of escape hatch sizes for bailout and ditching* (WCRD Technical Note 52-81). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 99 784)

White, W. J. (1949). *The effect of dial diameter on ocular movements and speed and accuracy of check reading groups of simulated engine instruments* (AF Technical Report 5826). Wright-Patterson AFB, OH: Air Materiel Command.

I have never known any professional and fully scientific psychologist who excelled Fitts in his ability to explain the contributions of human engineering to modern military and space problems.

— Leonard Carmichael, Vice President for Research and Exploration, National Geographic Society, June 1965, "Paul M. Fitts Memorial Issue," Human Factors Society Bulletin

White, W. J. (1951). *The effect of pointer design and pointer alignment position on the speed and accuracy of reading groups of simulated engine instruments* (AF Technical Report 6014). Wright-Patterson AFB, OH: Wright Air Development Center.

White, W. J., & Sauer, S. C. (1954). *Scale design for reading at low brightness* (WADC Technical Report 53-464). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 35 201)

White, W. J., Warrick, M. J., & Grether, W. F. (1953). Instrument reading: III. Check reading of instrument groups. *Journal of Applied Psychology, 37*, 302-307.

Wilcox, L. R., & Cole, E. L. (1952). *The effects of two instrument lighting systems on dark adaptation* (WADC Technical Report 52-263). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 5006)

Wilcox, L. R., & Grether, W. F. (1949). *Color markings for aircraft operating in Arctic regions* (AF Technical Report 5814). Wright-Patterson AFB, OH: Air Materiel Command.

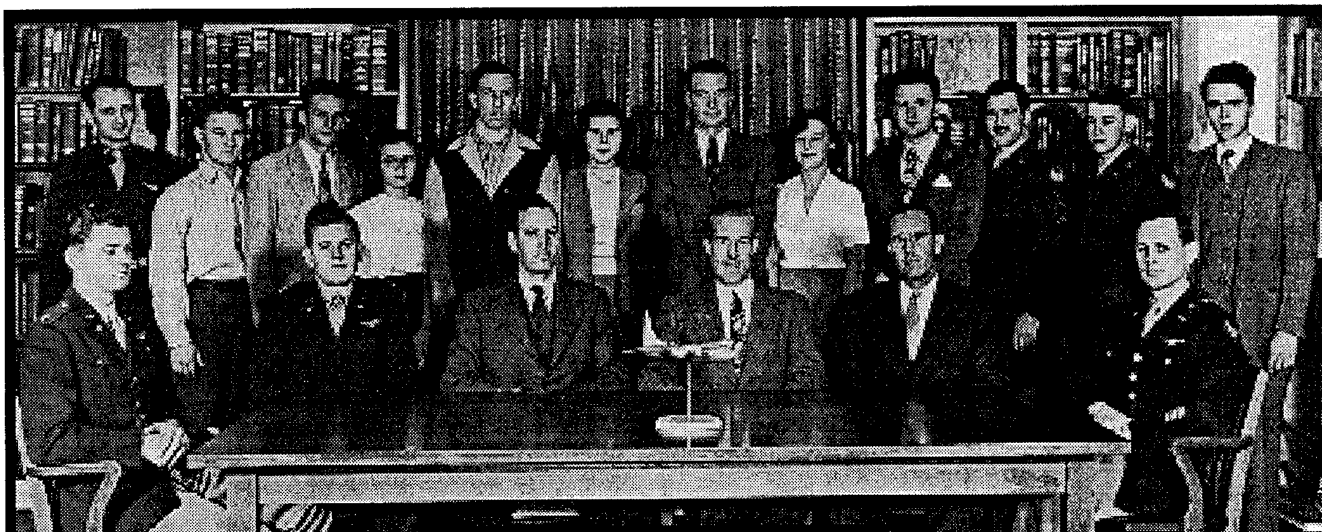
Wilson, C. L. (1950). *Some psychological problems in the use of periscopic-type instruments in aircraft* (AF Technical Report 5825). Wright-Patterson AFB, OH: Air Materiel Command.

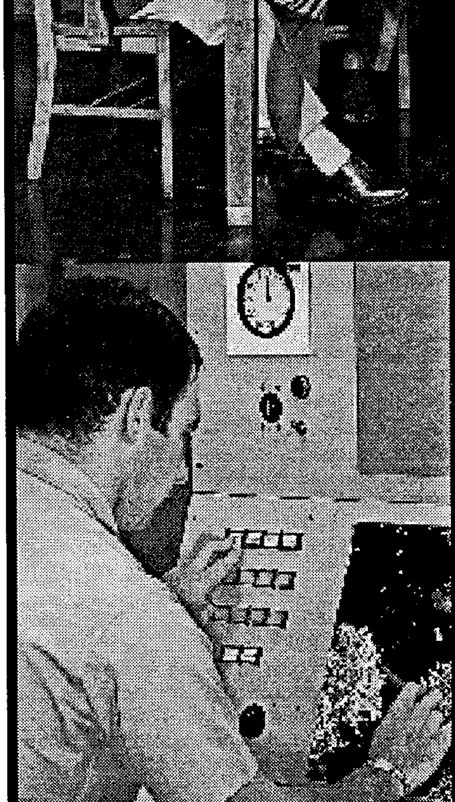
Wise, H. G., Jr. (1948). *A survey of current research and development on cockpit and instrument panel lighting systems by airlines and aircraft manufacturers* (AMC Memorandum Report MCREXD-694-8D). Wright-Patterson AFB, OH: Air Materiel Command.

Wulfeck, J. W. (1952). *Review of the literature on aeronautical chart development and design for use under red lighting* (WADC Technical Report 52-306). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 6458)

Wyckoff, L. B., Bridgman, C. S., & Tabory, L. (1954). *The effect of an improved orientation aid on target acquisition with the hemispheric sight* (WADC Technical Report 54-67). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 28 900)

Young, K. D. (1946). *Legibility of printed materials* (AMC Memorandum Report TSEAA-694-1A). Wright-Patterson AFB, OH: Air Materiel Command.

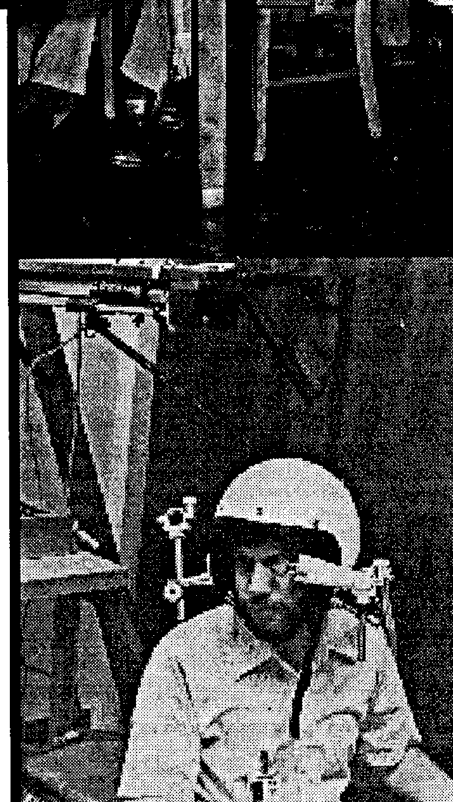


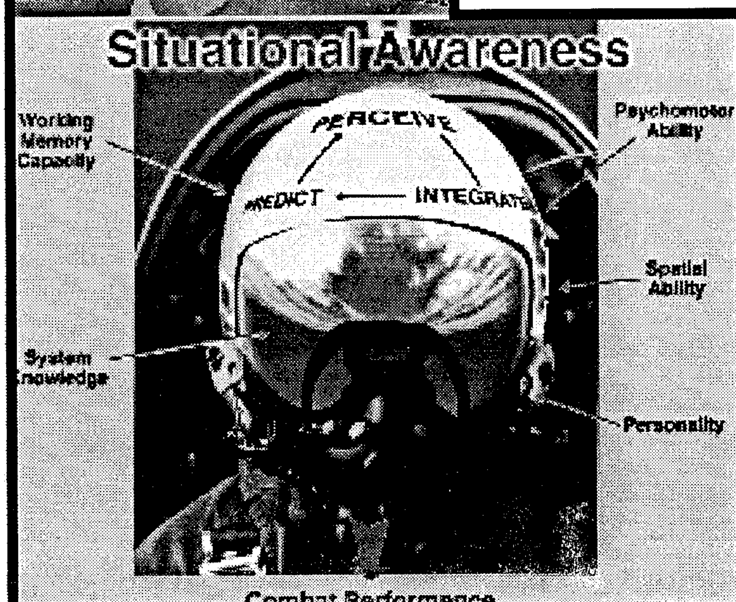


Preparing Man for Space Exploration

1955-1964

Sputnik will become a household word, and a daring young president challenges his nation to put a man on the moon and return him safely in the ensuing decade. The challenges are immense. Lt Col Fitts has left his indelible stamp of excellence on the Psychology Branch and moved on. The Grether years further fanned the flames of scientific excellence. The future of the Human Engineering Division is now turned over to Dr. Julien Christensen, ably assisted by Dr. Melvin Warrick.





Adams, O. S., & Chiles, W. D. (1960). *Human performance as a function of the work-rest cycle* (WADD Technical Report 60-248). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 240 654)

Adams, O. S., & Chiles, W. D. (1961). *Human performance as a function of the work-rest ratio during prolonged confinement* (ASD Technical Report 61-270). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 273 511)

Adams, O. S., Levine, R. B., & Chiles, W. D. (1959). *Research to investigate factors affecting multiple-task psychomotor performance* (WADC Technical Report 59-120). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 213 592)

Alexander, H. S., & Chiles, W. D. (1959). *An exploratory study of prolonged intermittent photic stimulation* (WADC Technical Report 59-715). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 233 854)

Alexander, H. S., & Chiles, W. D. (1960). Prolonged intermittent photic stimulation. *U.S. Armed Forces Medical Journal, 2,* 1156-1161.

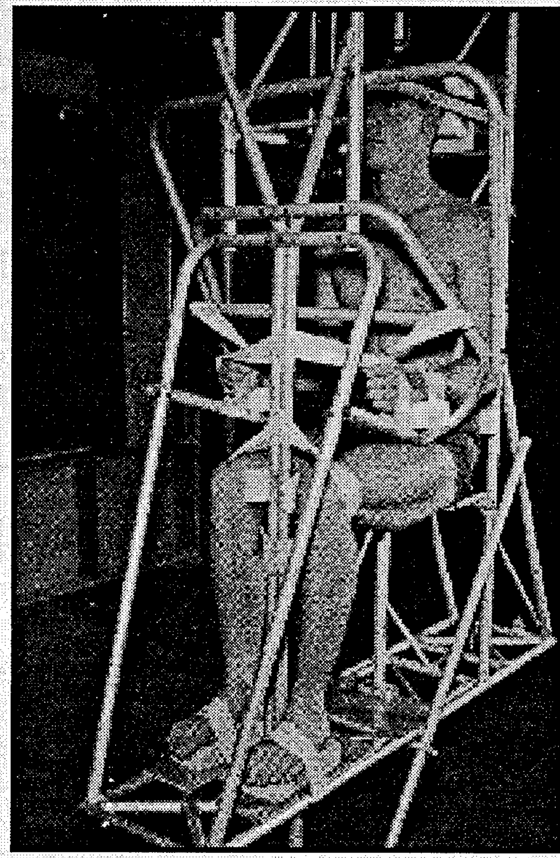
Alexander, M. et al. (1962). Anthropometry of Japanese pilots. *Japanese Aero-Medical Laboratory, 2*(2).

Alexander, M., & Hertzberg, H. T. E. (1957). *A comfort evaluation of a form-fitting high altitude helmet* (WADC Technical Report 56-404). Wright-Patterson AFB, OH: Wright Air Development Center.

Alexander, M., McConville, J. T., Kramer, J. H., & Fritz, E. A. (1964). *Height-weight sizing of protective garments, based on Japanese air self-defense force pilot data, with fit-test results* (AMRL Technical Documentary Report 64-66). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 606 039)

Alexander, M., Zeigen, R. S., & Emanuel, I. (1961). Anthropometric data presented in three-dimensional forms. *American Journal of Physical Anthropology, 19.*

Alluisi, E. A. (1955). *Measured visual acuity as a function of phenomenal size* (WADC Technical Report 55-384). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 90 914)



DETERMINING THE CENTER OF GRAVITY OF AN AIR CREWMAN

One of 118 subjects restrained in a pendulum apparatus to determine the center of gravity and moment of inertia of a sample of U.S. Air Force air crewmen. Subjects were selected to be representative in stature and weight of the Air Force population. The work was done under Task 718408, "Anthropology for Design" by J. DuBois, W.R. Santschi, D.M. Walton, C.O. Scott, and F.W. Mazy of North American Aviation, Inc. AMRL-TR-64-110 (1964)

Alluisi, E. A. (1956). *Computational formulae for a distribution-free test of analysis-of-variance hypotheses* (WADC Technical Report 56-339). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 110 445)

Alluisi, E. A. (Ed.). (1961). Lineal inclination in encoding information symbolically on cathode ray tubes and similar displays. (ASD Technical Report 61-741). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 278 825)

Alluisi, E. A., Chiles, W. D., & Hall, T. J. (1964). *Combined effects of sleep loss and demanding work-rest schedules on crew performance* (AMRL Technical Documentary Report 64-63). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 606 214)

Alluisi, E. A., Chiles, W. D., Hall, T. J., & Hawkes, G. R. (1963). *Human group performance during confinement* (AMRL Technical Documentary Report 63-87). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 426 661)

Alluisi, E. A., & Hall, T. J. (1962). *Group performance during four-hour periods of confinement* (MRL Technical Documentary Report 62-70). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC No. 283 842)

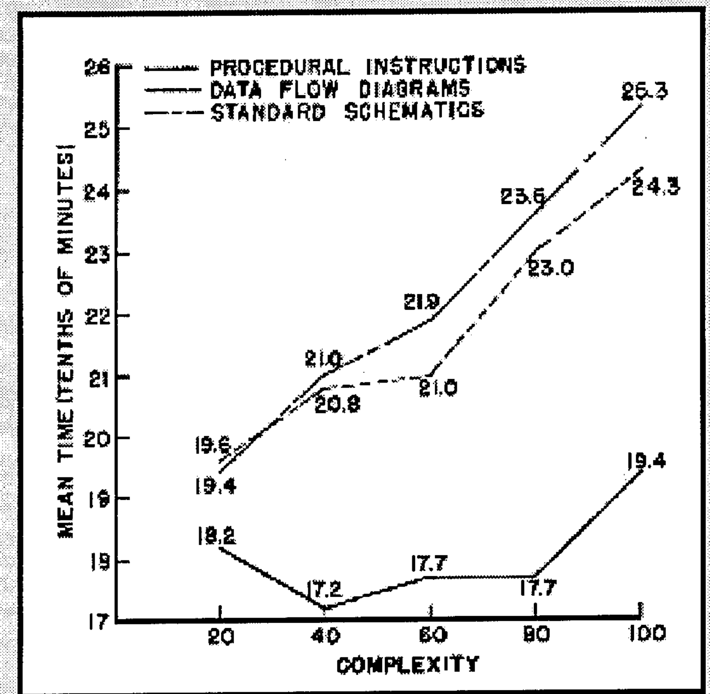
Alluisi, E. A., & Martin, H. B. (1957). *Comparative information-handling performance with symbolic and conventional Arabic numerals: Verbal and motor responses* (WADC Technical Report 57-196). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 160)

Alluisi, E. A., & Martin, H. B. (1958). An information analysis of verbal and motor responses to symbolic and conventional Arabic numerals. *Journal of Applied Psychology, 42,* 79-84.

Alluisi, E. A., & Muller, P. F., Jr. (1956). *Rate of information transfer with seven symbolic visual codes: Motor and verbal responses* (WADC Technical Report 56-226). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 112 454)

Alluisi, E. A., & Muller, P. F., Jr. (1958). Verbal and motor responses to seven symbolic codes: A study in S-R compatibility. *Journal of Experimental Psychology, 55,* 247-254.

Alluisi, E. A., Muller, P. F., Jr., & Fitts, P. M. (1955). *Rate of handling information and the rate of information presentation* (WADC Technical Note 55-745). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 91 878)



PRESENTATION TECHNIQUES FOR FAULT ISOLATION

Time to isolate equipment faults for three presentation techniques and five levels of complexity. AMRL-TR-64-57 (1964)

Alluisi, E. A., Muller, P. F., Jr., & Fitts, P. M. (1957). An information analysis of verbal and motor responses in a forced-paced serial task. *Journal of Experimental Psychology, 53,* 153-158.

Alluisi, E. A., & Sidorsky, R. C. (1958). The empirical validity of equal discriminability scaling. *Journal of Experimental Psychology, 55,* 86-95.

Alluisi, E. A., & Webb, I. B. (1956). *Four-place logarithms to the base 2 of three-digit numbers* (WADC Technical Note 56-499). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 110 581)

Altman, J. W. (1962). *Some procedures in design for maintainability* (MRL Technical Documentary Report 62-9). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC No. 278 804)

Altman, J. W., Marchese, A. C., & Marchiando, B. W. (1961). *Guide to design of mechanical equipment for maintainability* (ASD Technical Report 61-381). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 269 332)

Ammons, R. B., Alprin, S. I., & Ammons, C. H. (1955). Rotary pursuit performance as related to sex and age of pre-adult subjects. *Journal of Experimental Psychology, 49*, 127-133.

Ammons, R. B., Ammons, C. H., & Morgan, R. L. (1958). Movement analysis of the performance of a simple perceptual-motor task under various conditions. *Journal of General Psychology, 58*, 259-279.

Anderson, N. H., Grant, D. A., & Nystrom, C. O. (1956). The influence of the spatial positioning of stimulus and response components on performance of a repetitive key-pressing task. *Journal of Applied Psychology, 40*, 137-141.

Andresen, K. W., & Ewing, D. (1964). *A study of digital computers for a real time training simulation research system* (AMRL Technical Documentary Report 64-22). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 601 649)

Angrist, S. S. (1957). *The comparative interpretability of two aircraft attitude indicators* (WADC Technical Memorandum Report 57-8). Wright-Patterson AFB, OH: Wright Air Development Center.

Atchley, W. R., Ver Hulst, J., & Lehr, D. J. (1964). *Specification of optimum fault isolation presentation* (AMRL Technical Documentary Report 64-57). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 606 215)

Aume, N. M. (1963). *The effect of reach distance on reach time in a button-pushing task* (AMRL Memorandum Report P-58). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 425 558)

Aume, N. M. (1963). *Instructions for fabricating a digital laboratory timer* (AMRL Memorandum Report P-38). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 417 426)

Baker, C. A. (1955). *Formation lights for fighter aircraft* (WADC Technical Report 55-124). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 61 751)

Baker, C. A. (1960). Man's visual capabilities in space. *Proceedings of the Institute of Radio Engineers - Seventh East Coast Conference on Aeronautical and Navigational Electronics.*

Baker, C. A. (1960). *Visual aspects in collision avoidance of Air Force aircraft* (National Research Council Publication 712). Washington, DC: National Academy of Science.

Baker, C. A. (Ed.). (1963). Vision in Space. *Human Factors.*

Baker, C. A., Debons, A., & Morris, D. F. (1956). Dark adaptation as a function of the intensity and distribution of light across the preadaptation field. *Journal of the Optical Society of America, 46*, 401-404.

Baker, C. A., & Morris, D. F. (1957). Form recognition and detail resolution. *Minutes of the 25th International Congress of Psychology.*

Baker, C. A., Morris, D. F., & Steedman, W. C. (1960). Target recognition on complex displays. *Human Factors, 2*, 51.

Baker, C. A., & Steedman, W. C. (1961). Man's visual capabilities in space: Perceived movement in depth. *The 1961 Compendium of AFSC Symposium Papers* (pp. 1-29). Wright-Patterson AFB, OH: Air Force Systems Command.

Baker, C. A., & Steedman, W. C. (1961). Perceived movement in depth as a function of luminance and velocity. *Human Factors, 3*, 166.

"I was lucky enough to be on the selection committee for the original seven Project Mercury astronauts. I had done the anthropometry on all of the candidates, as well as stereo photographs. The photos were to be used to provide accurate body shape information, which would then enable us to make customized pressure suits . . . It was an interesting time in the lab for a few weeks, having all the astronaut candidates around taking tests, meeting, and discussing the results. All the candidates were very impressive, but John Glenn was in the 99th percentile on everything. He was amazing."

— Charles Clauser, Anthropologist
Human Engineering Division

Baker, C. A., & Steedman, W. C. (1961). Perceived movement in depth as a function of object luminance. *Science, 133,* 1356-1357.

Baker, C. A., & Steedman, W. C. (1962). Estimation of visually perceived closure rates. *Human Factors, 4,* 25-29.

Baker, C. A., & Vanderplas, J. M. (1957). Speed and accuracy of scale reading as a function of the number of reference markers. *Journal of Applied Psychology, 40,* 307-311.

Baker, D. F. (1960). *Task performance with the CRL model 8 master-slave manipulator as a function of object size, angle, and height of display* (WADD Technical Report 60-167). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 243 119)

Baker, D. F. (1961). *Remote-handling task performance as a function of indexing variables* (ASD Technical Report 61-626). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 277 815)

Baker, D. F. (1962). *Survey of remote handling in space* (AMRL Technical Documentary Report 62-100). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 288 863)

Baker, D. F., & Crawford, B. M. (1959). *Range limitations of the CRL model 8 master-slave manipulator with the seated operator* (WADC Technical Note 59-359). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 231 281)

By the 1950s, progress had been made at the lab that expanded work to include space research. Human engineering scientists studied the effects of weightlessness as well as the psychological problems peculiar to the spacecraft. They developed techniques to protect and enhance man's performance on supersonic rocket flights in new, high-altitude environments. Astronauts practiced working with new space tools during weightlessness missions while wearing bulky space suits and 160-pound backpacks which propelled them through space. They also learned how to assemble a space station and how to repair and retrieve satellites while in orbit.

— May 1985, "Human Engineering, Yesterday and Today," Civilian Employees Reporter

Baker, D. F., & Crawford, B. M. (1959). *Task performance with the CRL model 8 master-slave manipulator as a function of color-coding distance, and practice* (WADC Technical Report 59-728). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 233 457)

Bamford, H. E., Jr., & Ritchie, M. L. (1957). *Integrated instruments: A roll and turn indicator* (WADC Technical Report 57-205). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 170)

Bamford, H. E., Jr., & Ritchie, M. L. (1958). Complex feedback displays as a man-machine system. *Journal of Applied Psychology, 42,* 141-147.

Bamford, H. E., Jr., Ritchie, M. L., Angrist, S. S., & Wilson, S. E. (1956). *Effect of indicator frame on aircraft altitude interpretation* (WADC Technical Memorandum Report 56-7). Wright-Patterson AFB, OH: Wright Air Development Center.

Barcik, J. D. (1962). *Bibliography on memory* (MRL Memorandum Report P-1). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC No. 273 640)

Barling, H. B., Durant, J. R., Samson, R. L., & Wescott, H. W. (1959). *Programming techniques for communication and navigation facilities* (WADC Technical Report 59-792). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 231 260)

Barnes, G. H. (1955). *A cross-spectrum analyzer* (WADC Technical Report 55-445). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 98 319)

Barnes, G. H. (1955). *A four-channel noise source* (WADC Technical Report 55-194). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 76 879)

Barter, J. T. (1957). *Estimation of the mass of body segments* (WADC Technical Report 57-260). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 222)

Barter, J. T., & Alexander, M. (1956). *A sizing system for high altitude gloves* (WADC Technical Report 56-599). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 110 589)

Barter, J. T., Emanuel, I., & Truett, B. (1957). *A Statistical evaluation of joint range data* (WADC Technical Note 57-311). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 131 028)

Bauerschmidt, D. K., & Besco, R. O. (1962). *Human engineering criteria for manned space flight: Minimum manual systems* (AMRL Technical Documentary Report 62-87). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 288 513)

Benenati, A. T., Hull, R., Korobow, N., & Nienaltowski, W. (1962). *Development of an automatic monitoring system for flight simulators* (MRL Technical Documentary Report 62-47). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC No. 283 008)

Biagioni, J. R., McKelvey, R. K., & Mousted, J. F. (1958). *A radar mapping display simulation and performance recording device* (WADC Technical Note 58-210). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 203 396)

Bishop, H. P., & Crook, M. N. (1961). *Absolute identification of color for targets presented against white and colored backgrounds* (WADD Technical Report 60-611). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 266 403)

Blackwell, H. R., Ohmart, J. G., & Brainard, R. W. (1961). *Experimental evaluation of optical enhancement of literal visual displays* (ASD Technical Report 61-568). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 270 711)

Bowen, H. M., & Gradijan, J. M. (1963). *Graphical display of multiparametric information: Part II. Experimental studies of chart design* (AMRL Technical Documentary Report 62-115(II)). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 418 743)

Bowen, J. H., & Sharp, E. D. (1960). *Tables for mood's distribution-free interval estimation technique for differences between two medians* (WADD Technical Note 60-89). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 245 657)

"I was in the original Applications Branch, along with Charlie Bates, Dave Greek, and Austin Kibler. We were involved with the preparation of MIL-H-26-207, which was the first human factors data for guided missile systems. We drafted and finally got acceptance from the Air Force for that first human factors specification. The new spec could then be incorporated in the system development programs, which legitimized a lot of the human factors people who were in the aerospace industry at that time. It forced management to have human factors people in the loop in the design approval process. Human factors personnel had sign-off responsibility on all top-line drawings during the design process. This was a real "first;" it had considerable impact on the field."

— Donald Topmiller, Chief
Systems Research Branch
Human Engineering Division

Bradley, J. V. (1956). *Effect of gloves on control operation time* (WADC Technical Report 56-532). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 110 565)

Bradley, J. V. (1956). *Effect of knob arrangement on consumption of panel space* (WADC Technical Report 56-202). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 107 257)

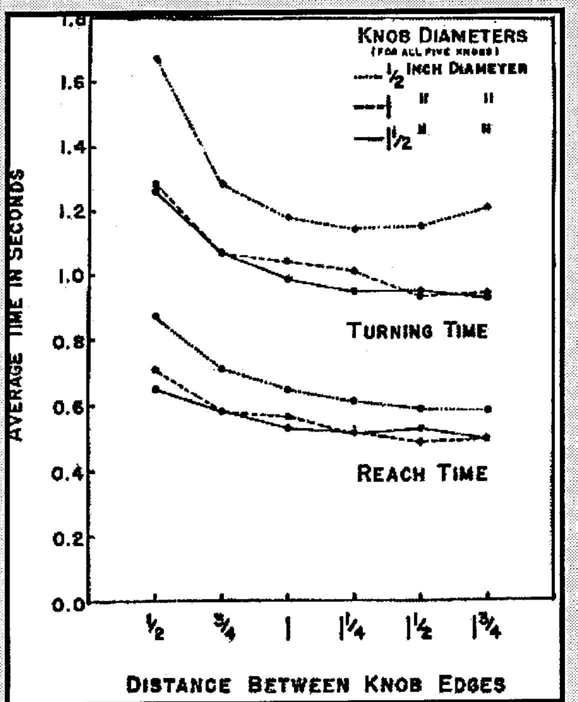
Bradley, J. V. (1957). Complete counterbalancing of immediate sequential effects in a Latin Square design. *Journal of the American Statistical Association, 53*, 525-528.

Bradley, J. V. (1957). Control knob arrangement can save aircraft instrument panel space. *Journal of Aviation Medicine, 28*, 322-327.

Bradley, J. V. (1957). *Glove characteristics influencing control manipulability* (WADC Technical Report 57-389). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 130 836)

Bradley, J. V. (1959). Direction-of-knob-turn stereotypes. *Journal of Applied Psychology, 43*, 21-24.

Bradley, J. V. (1959). *Studies in research methodology: I. Compatibility of psychological measurements with parametric assumptions* (WADC Technical Report 58-574(I)). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 230 977)



EFFECTS ON PERFORMANCE OF KNOB SIZE AND SPACING

Turning and reach times for knobs of different sizes as functions of distance between knob edges. From a study of minimum allowable knob crowding carried out by James Bradley and Norman E. Stump under Research and Development Task No. 71514 on control design and arrangement. WADC-TR-55-455 (1955)

Bradley, J. V. (1959). *Studies in research methodology: II. Consequences of violating parametric assumptions—fact and fallacy* (WADC Technical Report 58-574(II)). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 231 728)

Bradley, J. V. (1959). *Tactual coding of cylindrical knobs* (WADC Technical Report 59-182). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 232 961)

Bradley, J. V. (1959). *Utilization of multiple cues in paired comparisons* (WADC Technical Report 59-548). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 231 638)

Bradley, J. V. (1960). *Distribution-free statistical tests* (WADD Technical Report 60-661). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 249 268)

Bradley, J. V. (1961). A methodology for glove evaluation. *Perceptual and Motor Skills, 12*, 373-374.

Bradley, J. V. (1962). *Studies in research methodology: III. Persistence of sequential effects despite extended practice* (MRL Technical Documentary Report 62-60). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC No. 283 976)

Bradley, J. V. (1963). Rank order correlation scatter diagrams without plotting points. *American Statistician.*

Bradley, J. V. (1963). *Studies in research methodology: IV. A sampling study of the central limit theorem and the robustness of one-sample parametric tests* (AMRL Technical Documentary Report 63-29). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 422 649)

Bradley, J. V. (1963). *Studies in research methodology: V. Irrelevance in the T tests's rejection region* (AMRL Technical Documentary Report 63-109). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 431 210)

Bradley, J. V. (1964). *Studies in research methodology: VI. The central limit effect for a variety of populations and the robustness of Z, t and F* (AMRL Technical Report 64-123). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 612 886)

Bradley, J. V., & Arginteanu, J. (1956). *Optimum knob diameter* (WADC Technical Report 56-96). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 110 549)

Bradley, J. V., & Stump, N. E. (1955). *Minimum allowable dimensions for controls mounted on concentric shafts* (WADC Technical Report 55-355). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 93 135)

Bradley, J. V., & Stump, N. E. (1955). *Minimum allowable knob crowding* (WADC Technical Report 55-455). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 90 898)

Bradley, J. V., & Wallis, R. A. (1958). *Spacing of on-off controls: I. Push buttons* (WADC Technical Report 58-2). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 142 272)

Bradley, J. V., & Wallis, R. A. (1959). *Spacing of on-off controls: II. Toggle switches* (WADC Technical Report 58-475). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 212 270)

Bradley, J. V., & Wallis, R. A. (1959). Spacing of toggle switch on-off controls. *Journal of Engineering and Industrial Psychology, 1*, 107.

Bradley, J. V., & Wallis, R. A. (1960). Spacing of toggle switch on-off controls. *Journal of Engineering and Industrial Psychology, 2*(8).

Brainard, R. W., Irby, T. S., Fitts, P. M., & Alluisi, E. A. (1962). Some variables influencing the rate of gain of information. *Journal of Experimental Psychology, 63*, 105-110.

Brandalise, B. B., & Gottsdanker, R. M. (1959). The difference thresholds of the magnitude of visual acuity. *Journal of Experimental Psychology, 57*, 83-88.

Briggs, G. E. (1962). *Pursuit and compensatory modes of information display: A review* (AMRL Technical Documentary Report 62-93). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 288 888)

Brody, A. L., & Weinstock, S. (1962). *Mathematical theories in performance, decision making, and learning: A literature review* (MRL Technical Documentary Report 62-76). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC No. 285 565)

Brown, D. R., Naylor, J. C., & Briggs, G. E. (1963). *The retention of discrete and continuous tasks as a function of interim practice with modified task requirements* (AMRL Technical Documentary Report 63-35). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 408 980)

Brown, E. L. (1960). Research on human performance during zero gravity. In G. Finch (Ed.), *Air Force Human Engineering, Personnel, and Training Research* (NAS-NRC Publication 783, pp. 204-217). Washington, DC: National Academy of Science.

Brown, J. L. (1957). *Review of the cone-to-rod efficiency ratio as a specification for lighting systems* (WADC Technical Report 57-448). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 130 927)

Brown, J. L., Kuhns, M. P., & Adler, H. E. (1957). *The relations of threshold criterion to the functional receptors of the eye* (WADC Technical Report 57-449). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 130 928)

Buckhout, R. (1962). *A working bibliography on the effects of motion on human performance* (MRL Technical Documentary Report 62-77). Wright-Patterson AFB, OH: Materiel Research Laboratory. (DTIC No. 287 530)

Buckhout, R., Goldsmith, C. T., Sherman, H., & Vitale, P. A. (1963). *The effect of variations in motion fidelity during training on simulated low-altitude flight* (AMRL Technical Documentary Report 63-108). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 435 543)

Buddenhagen, T. F., Johnson, A. B., Stephas, S. C., & Wolpin, M. P. (1963). *Development of visual simulation techniques for astronautical flight training, Vol. I. High resolution television; Electronic planetarium* (AMRL Technical Documentary Report 63-54(1)). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 412 641)

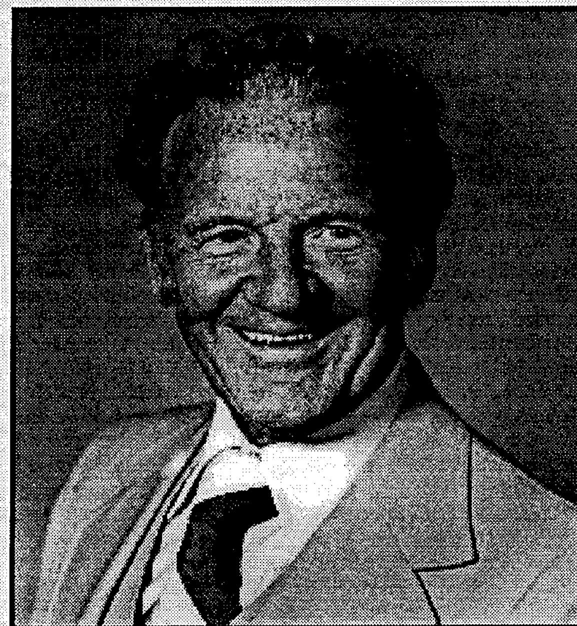
Buddenhagen, T. F., & Wolpin, M. P. (1961). *A study of visual simulation techniques for astronautical flight training* (WADD Technical Report 60-756). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 260 093)

Bunning, H. (1961). *Flight simulation of orbital and reentry vehicles: III. Aerodynamics information required for six degrees of freedom simulation* (ASD Technical Report 61-171 (III)). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 282 995)

Cameron, R. G. (1963). *Development of an analog multiplier, based on Hall Effect* (AMRL-TDR-63-50). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 410 897)

Chiles, W. D. (1955). *The effects of sleep deprivation on performance of a complex mental task* (WADC Technical Note 55-423). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 100 691)

Julien M. Christensen, PhD
Chief, Human Engineering Division
1956 to 1974



Julien M. Christensen was assigned as a first lieutenant, US Army Air Force, to the Psychology Branch, Aero Medical Laboratory in October 1945. When he separated from military service as a captain in 1946, he was hired immediately by Lt Col (Dr.) Paul Fitts, Chief of the Psychology Branch. Prior to that time, Chris had been a personnel technician in the Trade Test Division of the US Army's Adjutant General's Office (1941) and in the US Army Air Force's Aviation Psychology program conducting research on navigator selection. He went through Navigator Cadet training and later radar/bombardier training and was assigned to the Army's Aviation Psychology program doing research on navigator training.

He became Chief of the (renamed) Human Engineering Division in 1956, a position he held until retirement from civil service in 1974. Chris supervised an interdisciplinary team of over 60 engineers, scientists, and technicians in human factors research and development programs for the United States Air Force. These programs included visual perception, displays, controls, control dynamics, environmental factors, performance modeling, maintainability, human reliability, information processing, decision making, safety, and physical anthropology. He was particularly honored by being elected to the International Explorers and Pole Vaulters Club, being the first civilian scientist to fly with the Air Force over the North Pole (1947). He chaired the Human Performance Advisory Committee, Manned Orbiting Laboratory, and contributed heavily to various bioastronautical and other long-term programs. He was twice (1964-65 and 1986-87) President of the international Human Factors and Ergonomics Society and was awarded an honorary Doctor of Science degree (1989) by the University of Dayton. Subsequent to his retirement from civil service, he became Chairman (1974-1978) of the Department of Industrial Engineering, Wayne State University. Following that, he became Chief Scientist, General Physics Corporation from 1980 to 1984 and later a consultant and Senior Human Factors Scientist at Universal Energy Systems in Dayton, Ohio.

Chiles, W. D. (1955). *Experimental studies of prolonged wakefulness* (WADC Technical Report 55-395). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 100 698)

Chiles, W. D. (1957). *Psychological stress as a theoretical concept* (WADC Technical Report 57-457). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 130 942)

Chiles, W. D. (1958). Effects of elevated temperatures on performance of a complex mental task. *Ergonomics, 89.*

Chiles, W. D. (1958). *Effects of high temperatures on performance of a complex mental task* (WADC Technical Report 58-323). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 155 811)

Chiles, W. D. (1958). Effects of shock-induced stress on verbal performance. *Journal of Experimental Psychology, 58,* 159-165.

Chiles, W. D., & Adams, O. S. (1961). *Human performance and the work-rest schedule* (ASD Technical Report 61-270)Aeronautical Systems Division. (DTIC No. 266 033)

Chiles, W. D., Cleveland, J. M., & Fox, R. E. (1960). *A study of the effects of ionized air on behavior* (WADD Technical Report 60-598). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 252 099)

Chiles, W. D., & Custer, C. L. (1963). *Summaries of research on the human performance effects of vibration* (Report No. AMRL-TR-67-172). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 666 425)

Chiles, W. D., Fox, R. E., Rush, J. H., & Stilson, D. W. (1962). *Effects of ionized air on decision making and vigilance performance* (MRL Technical Documentary Report 62-51). Wright-Patterson AFB, OH: Materiel Research Laboratory. (DTIC No. 283 460)

Chiles, W. D., Knott, J. R., & Ingram, W. D. (1955). Effects of sub-cortical lesions on cortical electroencephalogram in cats. *American Medical Association Archives of Neurology and Psychiatry, 73*, 203-215.

Christensen, J. M. (1955). *The importance of certain dial design variables in quantitative instrument reading* (WADC Technical Report 53-376). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 97 492)

Christensen, J. M. (1957). Les rouages de l'homme. *Revue De Psychologie Appliquee, 7*, 153.

Christensen, J. M. (1958). Trends in human factors. *Human Factors, 1*, 2-7.

Christensen, J. M. (1959). *Inspection of AN/CPS-6B* (AMC Memorandum Report MCREXD-694-24). Wright-Patterson AFB, OH: Air Materiel Command.

Christensen, J. M. (1960). Conversations about the ethical use of knowledge. *Convocation Proceedings*. Berea, OH: Baldwin-Wallace College.

Christensen, J. M. (1961). Engineering for the human. In F. A. Geldard, & M. C. Leed (Eds.), *Proceedings of the First International Symposium on Military Psychology* (NAS-NRC Publication 894, pp. 51-59). Washington, DC: National Academy of Sciences.

Christensen, J. M. et al. (1961). *The role of man in automated systems: Working Group XIII of NATO long-range scientific planning committee*. Naples, Italy: Cinsouth.

Christensen, J. M. et al. (1961). Training in engineering psychology. *The American Psychologist, 16*.

Christensen, J. M. (1962). The evolution of the systems approach in human factors engineering. *Human Factors, 4*(I).

Christensen, J. M. (1963). Psychological aspects of extended manned space flight. *Advances in the Astronautical Sciences, 15*.

Christensen, J. M. (1963). The use of space to study man. *PSI CHI Quarterly*.

Christensen, J. M. (1964). *The emerging role of engineering psychology* (AMRL Technical Report 64-88). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 608 215)

Christensen, J. M. (1964). Human engineering: Past, present, future. *Bioenvironmental Symposium*. Brooks AFB, TX: Aerospace Medical Division.

Christensen, J. M. (1964). *Human performance considerations for the Manned Orbiting Laboratory (MOL) program*. Wright-Patterson AFB, OH: Human Performance Sub-Panel, Behavioral Sciences Laboratory.

Christensen, J. M. (1964). The measurement of general performance in military space systems. *Proceedings of the Ninth Annual Symposium on Ballistic Missiles and Space Technology, 4*.

Christensen, J. M., & Crannell, C. W. (1955). *The effect of selected visual training procedures on the visual form field* (WADC Technical Report 54-239). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 76 423)

Christensen, K. K., & Johnson, L. L. (1959). *Study to determine methods of simulating G effects* (WADC Technical Note 58-314). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 211 849)

Chubb, G. P. (1964). *A comparison of performance in operating the CRL-8 master slave manipulator under monocular and binocular viewing conditions* (AMRL Technical Documentary Report 64-68). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 608 791)

Chubb, G. P. (1964). *An evaluation of proposed applications of remote handling in space* (AMRL Technical Report 64-98). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 608 802)

Churchill, E. (1963). Statistics for functions of anthropometric and "somatolytic variables," Body Composition, Part I. *Annals of the New York Academy of Science, 110.*

Churchill, E., & Bernhardi, K. (1957). *WAF trainee body dimensions: A correlation matrix* (WADC Technical Report 57-197). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 161)

Churchill, E., Kuby, A., & Daniels, G. S. (1957). *Nomograph of the hand and its related dimensions* (WADC Technical Report 57-198). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 162)

Churchill, E., & Truett, B. (1957). *Metrical relations among dimensions of the head and face* (WADC Technical Report 56-621). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 110 629)

Cohen, J. (1955). *Binocular disparity as a coding dimension for pictorial instrument and radar displays* (WADC Technical Report 55-393). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 93 633)

Cohen, J., & Dinnerstein, A. J. (1958). *A comparison of a linear scale and three logarithmic scales on the time for check reading* (WADC Technical Report 57-63). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 017)

Cohen, J., & Dinnerstein, A. J. (1958). *Flash rate as a visual coding dimension for information* (WADC Technical Report 57-64). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 018)

Cohen, J., & Senders, V. L. (1958). *The effects of absolute and conditional probability distributions on instrument readings: III. A comparison of a linear scale and two scales with expanded central portions* (WADC Technical Report 57-65). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 019)

A SUBJECT USING BIMODAL CONTROLS TO OBTAIN DATA FOR DESIGN CRITERIA

A subject being tested on simultaneous activation of bimodal controls in a study done under Project 7184, "Human Performance in Advanced Systems," Task 718404, Advanced Systems Human Engineering Design Criteria. The work was performed by Melvin J. Warrick and Lester Turner. AMRL TDR-63-6 (1963)

Clark, D. C., Deleys, N. J., & Matheis, C. W. (1961). *Exploratory investigation of the man amplifier concept* (AMRL Technical Documentary Report 62-89). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 290 070)

Clauser, C. E. (1959). *Anthropometric studies: Project mercury candidate evaluation program* (WADC Technical Report 59-505). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 234 749)

Clauser, C. E. (1964). The role of comparative anthropometry in aerospace anthropology. *Symposium on Aerospace Anthropology.* Phoenix, AZ: Stein Engineering Services, Inc.

Conover, D. W. (1959). *The amount of information in the absolute judgment of munsell hues* (WADC Technical Note 58-262). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 233 445)

Conover, D. W., & Kraft, C. L. (1958). *The use of color in coding displays* (WADC Technical Report 55-471). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 204 214)

Contini, R., Drillis, R., & Slote, L. (1959). *Development of techniques for the evaluation of high altitude pressure suits* (WADC Technical Report 58-641). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 240 563)

Corbett, D. G., Diamantides, N. D., & Krause, R. H. (1964). *Measurements and models for relating the physical characteristics of images to target detection* (AMRL Technical Report 64-117). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 610 254)

Cotterman, T. E. (1960). *Effects of variations in specificity of knowledge of results on the improvement of a perceptual skill* (WADC Technical Report 58-673). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 246 349)

Crannell, C. W., & Christensen, J. M. (1955). *Expansion of the visual form field by perimeter training* (WADC Technical Report 55-368). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 99 643)

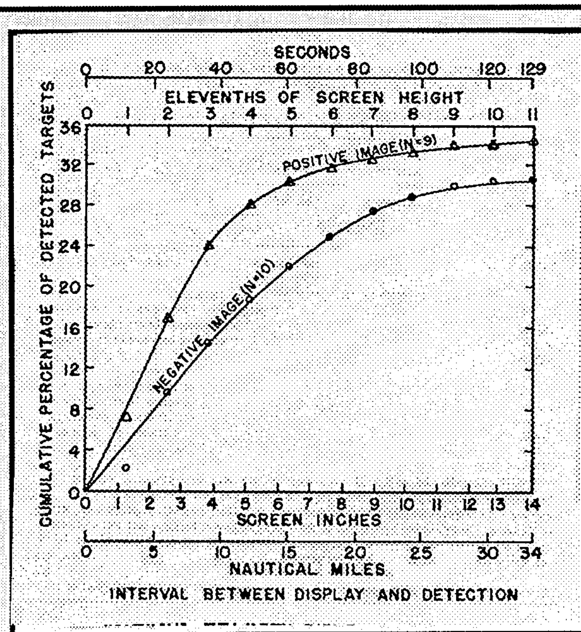
Crannell, C. W., & Debons, A. (1958). *Illumination and tilt as factors in the legibility of reflex-reflective numerals* (WADC Technical Report 58-47). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 142 327)

Crannell, C. W., & Topmiller, D. A. (1963). *Effect of grouping on the time required to locate and respond to the elements of a large control panel* (AMRL Technical Documentary Report 63-34). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 410 998)

Crawford, B. M. (1960). *Task performance with the CRL model 8 master-slave manipulator as a function of color-coding distance and practice* (ASME Paper 60-SA-37). American Society of Mechanical Engineers.

Crawford, B. M. (1961). *Measures of remote manipulator feedback: Absolute judgments of weight* (WADD Technical 60-591(II)). Wright-Patterson AFB, OH: Wright Air Development Division.

Crawford, B. M. (1961). *Measures of remote manipulator feedback: Differential sensitivity



TARGET DETECTION AS A FUNCTION OF IMAGE POLARITY

Data comparing detection of targets with positive and negative image polarity on a side-looking radar display. The work was performed jointly under Program 665A, "Precision Strike," and Task 718404, "Advanced Systems Human Engineering Design Criteria." The work was performed by Barbara A. Van Ausdall and Dr. Herschel C. Self. AMRL-TR-64-82 (1964)

for weight (WADD Technical Report 60-591(I)). Wright-Patterson AFB, OH: Wright Air Development Division.

Crawford, B. M. (1964). Joy stick vs. multiple levers for remote manipulator control. *Human Factors, 6*, 39-48.

Crawford, B. M., & Baker, D. F. (1960). *Human factors in remote handling: Survey and bibliography* (WADD Technical Report 60-476). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 242 524)

Crawford, B. M., & Baker, D. F. (1963). Human engineering evaluation of shielded cab, remote-handling vehicle. *USAF Shielded Cab Vehicles Test and Evaluation* (AFSWC Technical Documentary Report 62-137, pp. 199-234). (DTIC No. 402 748)

Crawford, B. M., & Kama, W. N. (1961). *Remote handling of mass* (ASD Technical Report 61-627). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 273 491)

Damon, A. H., Stoudt, H., & McFarland, R. (1963). Anthropometry. In Morgan et al. (Eds.), *Human Engineering Guide to Equipment Design*. New York: McGraw-Hill.

Davis, J. F. (1959). *Manual of surface electromyography* (WADC Technical Report 59-184). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 234 044)

Debons, A., & Chiles, W. D. (1957). *The effects of cold on psychophysical weight judgments: A methodological study* (WADC Technical Note 57-305). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 131 004)

Debons, A., & Crannell, C. W. (1957). *Facilitating identification of aircraft by use of reflex-reflective ("scotchlite") material* (WADC Technical Report 57-130). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 094)

Debons, A., & Crannell, C. W. (1958). The legibility of "scotchlite" versus other materials. *Journal of Applied Psychology, 42*, 389-395.

Deese, J. (1956). *The ability of untrained observers to match visual forms that are slightly disparate in contour* (WADC Technical Report 56-570). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 110 535)

Deese, J. (1956). *Complexity of contour in the recognition of visual form* (WADC Technical Report 56-60). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 94 610)

Deese, J. (1957). *Changes in visual performance after visual work* (WADC Technical Report 57-285). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 266)

Dempsey, C. A., Grenier, T. H., Burch, N. R., Chiles, W. D., & Steele, J. E. (1956). The human factors in long range flight. *Journal of Aviation Medicine, 27*, 18-22.

Dempsey, C. A., Grenier, T. H., Chiles, W. D., Burch, N. R., Warren, D., Schmitt, N. E., & Steele, J. E. (1955). 56 Hours in Jet Planes. *Science News Letter, 67*, 2l1.

Dempster, W. T. (1955). The anthropometry of body action. *Annals of the New York Academy of Science, 63*, 559-585.

Dempster, W. T. (1955). *Space requirements of the seated operator geometrical, kinematic, and mechanical aspects of the body with special reference to the limbs* (WADC Technical Report 55-159). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 87 892)

Dempster, W. T., Gabel, W. C., & Felts, W. J. L. (1959). Anthropometry of manual work space for the seated subject. *American Journal of Physical Anthropology, 17*, 289-317.

Diamond, A. L., & Gilinsky, A. S. (1955). Dark-adaptation luminance thresholds for the resolution of detail following different durations of light adaptation. *Journal of Experimental Psychology, 50*, 134-143.

DuBois, J., Santschi, W. R., Walton, D. M., Scott, C. O., & Mazy, F. W. (1964). *Moments of inertia and centers of gravity of the living human body encumbered by a full-pressure suit* (AMRL Technical Report 64-110). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 609 863)

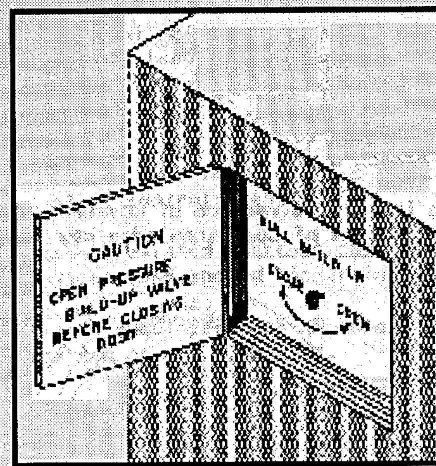
Dupertuis, C. W., & Emanuel, I. (1956). *A statistical comparison of the body typing methods of Hooton and Sheldon* (WADC Technical Report 56-366). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 97 205)

Dzendolet, E. (1960). The ability to apply forces while tractionless. *Proceedings of the Institute of the Environmental Sciences Meeting.*

Dzendolet, E. (1960). *Manual application of impulses while tractionless* (WADD Technical Report 60-129). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 238 021)

Dzendolet, E., & Rievley, J. F. (1959). *Man's ability to apply certain torques while weightless* (WADC Technical Report 59-94). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 220 363)

Eckstrand, G. A., & Morgan, R. L. (1956). *The influence of training on the tactual discriminability of knob shapes* (WADC Technical Report 56-8). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 94 606)



DESIGNING FOR MAINTAINABILITY

An example of labeling instructions for hazardous tasks; taken from a guide for designing mechanical equipment for maintainability. This work examined design factors for accesses, connectors, fasteners, labels, instructions, etc. and made recommendations for maintenance of support equipment. The work was done under Task 71586, "Design for Maintainability," by James W. Altman, Angeline C. Marchese, and Barbara W. Marchiando of the American Institute for Research. ASD TR-61-381 (AD 269 332)(1961)

Eisen, L., & Zeigen, R. S. (1959). *A supine seat for high-stress testing of primates* (WADC Technical Report 59-165). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 219 894)

Eisley, J. G. (1958). *An investigation of the relative effect of stability derivatives on the dynamic characteristics of the F-106A* (WADC Technical Note 58-235). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 222 890)

Elkin, E. H. (1959). *Effects of scale shape, exposure time, and display-response complexity on scale-reading efficiency* (WADC Technical Report 58-472). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 209 381)

Elliott, T. K., & Folley, J. D., Jr. (1964). *The maintenance task simulator-1 (MTS-1): A device for electronic maintenance research* (AMRL Technical Report 64-99). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 608 745)

Ely, J. H., Bowen, H. M., & Orlansky, J. (1957). *Man-machine dynamics: The joint services human engineering guide to equipment design: Chapter VII* (WADC Technical Report 57-582). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 131 082)

Ely, J. H., Thomson, R. M., & Orlansky, J. (1956). *Design of controls: The joint services human engineering guide to equipment design: Chapter VI* (WADC Technical Report 56-172). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 023)

Ely, J. H., Thomson, R. M., & Orlansky, J. (1956). *Layout of workplaces: The joint services human engineering guide to equipment design: Chapter V* (WADC Technical Report 56-171). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 110 507)

Emanuel, I., & Alexander, M. (1957). *Height-weight sizing and fit-test of a cutaway G-suit, type CSU-3/P* (WADC Technical Report 57-432). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 130 912)

Emanuel, I., Alexander, M., & Churchill, E. (1959). *Anthropometric sizing and fit-test of the MC-1 Oral-Nasal Oxygen Mask* (WADC Technical Report 58-505). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 213 604)

Emanuel, I., Alexander, M., Churchill, E., & Truett, B. (1959). *A height weight sizing system for flight clothing* (WADC Technical Report 56-365). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 130 917)

Emanuel, I., & Barter, J. T. (1957). *Linear distance changes over body joints* (WADC Technical Report 56-364). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 003)

Emanuel, I., Chaffee, J. W., & Wing, J. (1956). *A study of human weight lifting capabilities for loading ammunition into the F-86H Aircraft* (WADC Technical Report 56-367). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 97 206)

Erdman, A. C., Fontaine, A. B., & McConnell, D. C. (1959). *The amplitude analyzer* (WADC Technical Report 59-45). Wright-Patterson AFB, OH: Wright Air Development Center.

Eriksen, C. W. (1955). Partitioning and saturation of visual displays and efficiency of visual search. *Journal of Applied Psychology, 39*, 73-77.

Eriksen, C. W., & Hake, H. W. (1955). Absolute judgments as a function of stimulus range and the number of stimulus and response categories. *Journal of Experimental Psychology, 49*, 323-332.

Eriksen, C. W., & Hake, H. W. (1955). Multidimensional stimulus differences and accuracy of discrimination. *Journal of Experimental Psychology, 50*, 153-160.

Eriksen, C. W., & Hake, H. W. (1956). *Anchor effects in absolute judgments* (WADC Technical Report 56-144). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 94 834)

Erlick, D. E. (1959). *Judgments of the relative frequency of sequential binary events: Effects of frequency differences* (WADC Technical Report 59-580). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 232 139)

Erlick, D. E. (1960). *Judgments of the relative frequency of two random sequential events: Effects of duration of observation* (WADD Technical Report 60-673). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 247 334)

Erlick, D. E. (1961). Judgments of the relative frequency of a sequential series of two events. *Journal of Experimental Psychology, 62*, 105-112.

Erlick, D. E. (1962). The ability to filter noise from a visual task when the noise and signal are presented sequentially. *Journal of Experimental Psychology, 63*(2), 111-115.

Erlick, D. E. (1962). Perception of the most frequent category of a random series as a function of the number of categories. *Journal of Experimental Psychology, 63*(2), 115-119.

Erlick, D. E. (1963). Effects of grouping and stimuli on the perception of relative frequency. *Journal of Experimental Psychology, 66*(3), 314-316.

Erlick, D. E. (1963). Effects of method of displaying categories on the perception of relative frequency. *Journal of Experimental Psychology, 66*, 316-318.

Erlick, D. E. (1964). Absolute judgments of discrete quantity randomly distributed over time. *Journal of Experimental Psychology, 67*, 475-482.

Erlick, D. E., & Hunt, D. P. (1957). *Evaluating audio warning displays for weapon systems* (WADC Technical Report 57-222). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 189)

Erlick, D. E., & Palmore, J., Jr. (1961). *Judgments of the relative frequency of two random sequential events: Effects of rate of presentation* (WADD Technical Report 60-714). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 255 149)

Ernst, A. A. (1959). *Feasibility study for a man-machine systems research facility* (WADC Technical Report 59-51). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 213 589)

Feallock, J. B., & Briggs, G. E. (1963). *A multiman-machine system simulation facility and related research on information-processing and decision-making tasks* (AMRL Technical Documentary Report 63-48). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 411 552)

Fitts, P. M., Schipper, L. M., Kidd, J. S., Shelly, M. W., & Kraft, C. (1958). Some concepts and methods for the conduct of system research in a laboratory setting. In G. Finch, & F. Cameron (Eds.), *Air Force Human Engineering, Personnel, and Training Research* (NAS-NRC Publication No. 516, pp. 174-187). Washington, DC: National Academy of Sciences-National Research Council.

Fitts, P. M., & Schneider, R. (1955). Reproduction of simple movements as a function of factors influencing prioceptive feedback. *Journal of Experimental Psychology, 49*, 445-454.

TESTING AN EARLY MODEL OF AN EXTRA-VEHICULAR PROPULSION UNIT

Sgt Bill Sears in a C-131B aircraft wearing a jet-propelled, manual-control extra-vehicular propulsion unit called a locomotion belt while assessing a human's ability to rotate his body in a zero-gravity environment. After considerable experimentation and design effort, these propulsion units were developed into the equipment used by the American astronauts for extra-vehicular excursions. The aircraft was flying in a parabolic flight path or orbit to produce the free-fall condition of zero gravity such as occurs in an earth-orbiting space vehicle. This picture was taken during an experiment in 1961.

Flexman, R. E., Seale, L. M., & Henderson, C. (1963). *Development and test of the bell zero-G belt* (AMRL Technical Documentary Report 63-23). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 409 620)

Fogarty, L. E., & Howe, R. M. (1961). *Flight simulation of orbital and reentry vehicles: Part II. A modified flight path axis system for solving the six-degree-of-freedom flight equations* (ASD Technical Report 61-171(II)). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 269 283)

Folley, J. D., Jr. (1961). *A preliminary procedure for systematically designing performance aids* (ASD Technical Report 61-550). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 270 866)

Folley, J. D., Jr. (1961). *Research problems in the design of performance aids* (ASD Technical Report 61-548). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 270 866)

Folley, J. D., Jr., & Altman, J. W. (1956). *Guide to design of electronic equipment for maintainability* (WADC Technical Report 56-218). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 101 729)

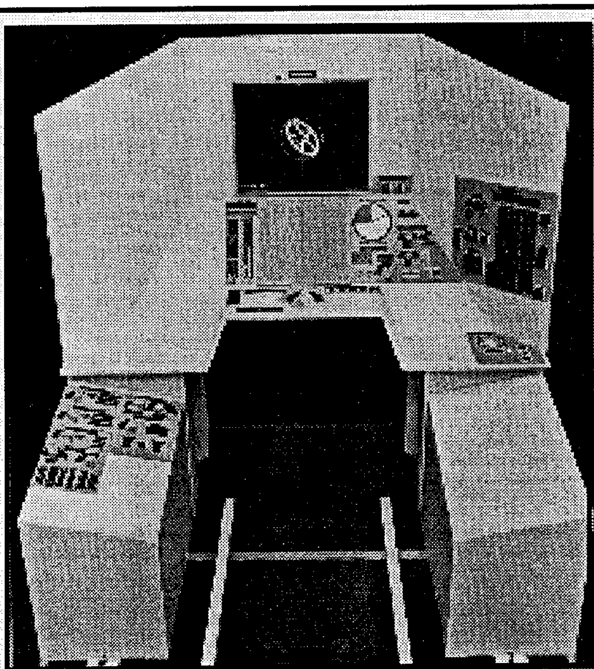
Folley, J. D., Jr., & Munger, S. J. (1961). *A review of the literature on design of informational job performance aids* (ASD Technical Report 61-549). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 270 867)

Folley, J. D., Jr., & Shettel, H. H. (1962). *Tryout of a preliminary procedure for systematically designing performance aids* (MRL Technical Documentary Report 62-20). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC No. 283 605)

Frost, G. G. (1961). *An application of a dynamic pilot-model to system design* (ASD Technical Note 61-57). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 265 607)

Frost, G. G. (1962). *A comparison between tracking with "optimum" dynamics and tracking with a simple velocity control* (AMRL Technical Documentary Report 62-150). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 402 843)

Frost, G. G. (1962). *A review of scoring methods for tracking tasks* (AMRL Memorandum Report P-14). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 287 269)



DISPLAYS AND CONTROLS FOR MANNED SPACE FLIGHT

Cockpit mockup used in a study of display and control requirements for manned space flight. This work was done under Project No. 7184, "Human Performance in Advanced Systems," and Project No. 7185, "Design Criteria for Crew Stations in Advanced Systems." The work was done by Charles O. Hopkins, Donald K. Bauerschmidt and M.J. Anderson of the Hughes Aircraft Company. WADD-TR-60-197 (1960)

Frost, G. G. (Contributor). (1964). The human operator. In P. Webb (Ed.), *Bio-Astronautics Data Book: Section 18* (NASA SP-3006). Washington, DC: National Aeronautics and Space Administration.

Fry, E. I., & Churchill, E. (1956). *Bodily dimensions of the older pilot* (WADC Technical Report 56-459). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 97 217)

Gain, P., & Fitts, P. M. (1959). *A simplified electronic tracking apparatus (SETA)* (WADC Technical Report 59-44). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 233 850)

Gardner, J. F. (1957). *The effect of motion relationship and rate of pointer movement on tracking performance* (WADC Technical Report 57-533). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 131 002)

Gardner, J. F., Lacey, R. J., Seeger, C. M., & Wade, J. E. (1957). *In-flight comparison of pilot performance on a standard USAF and an experimental instrument panel* (WADC Technical Report 57-270). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 255)

Gardner, J. F., Seeger, C. M., & Warrick, M. J. (1956). *Human engineering operational suitability of the B-57B* (WADC Technical Note 56-73). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 103 242)

Gerhardt, L., & Johnson, A. B. (1963). *Development of visual simulation techniques for astronautical flight training, Volume II: Image assembly techniques for visual simulation of orbiting flight* (AMRL Technical Documentary Report 63-54(11)). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 427 318)

Gray, M. A. (1963). *An analytic study of man's inertial properties* (GAE/Mech 63-9 (USAFIT))

Graybiel, A., & Kellogg, R. S. (1964). The inversion illusion: Its dependence on otolith function. *Proceedings of the Third International Symposium on Bioastronautics and Space Flight* Brooks AFB, TX.

Green, M. R., & Muckler, F. A. (1959). *Speed of reaching to critical control areas in a fighter-type cockpit* (WADC Technical Report 58-687). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 216 298)

Greenwood, D. T. (1960). *An extended euler angle coordinate system for use with all-attitude aircraft simulators* (WADD Technical Report 60-372). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 249 068)

Grether, W. F. (1963). Visual search in the space environment. *Human Factors, 5*, 203-209.

Gustafson, C. E. (1960). *A method of estimating surface color discriminability for coding training equipment and predicting label legibility* (WADD Technical Note 60-83). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 243 721)

Hake, H. W. (1957). *Contributions of psychology to the study of pattern vision* (WADC Technical Report 57-621). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 142 035)

Hake, H. W., & Averbach, E. (1955). *Apparent and real resolution in radar visibility* (WADC Technical Report 55-459). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 94 316)

Hake, H. W., & Eriksen, C. W. (1955). Effect of number of permissible response categories on learning of a constant number of visual stimuli. *Journal of Experimental Psychology, 50,* 161-167.

Hake, H. W., & Eriksen, C. W. (1955). *Recognition and identification of complex visual forms as a function of the labeling system employed* (WADC Technical Report 55-367). Wright-Patterson AFB, OH: Wright Air Development Center.

Hake, H. W., & Eriksen, C. W. (1956). Role of response variables in recognition and identification of complex visual forms. *Journal of Experimental Psychology, 52,* 235-243.

Hall, E. R. (1963). *The checkout and maintenance (CAM) trainer* (AMRL Memorandum Report P-35). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 409 585)

Hall, E. R., Modrick, J. A., & Richard, P. R. (1963). *The checkout and maintenance (CAM) trainer: I. Instructions and programs for use* (AMRL Memorandum Report P-39). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 413 524)

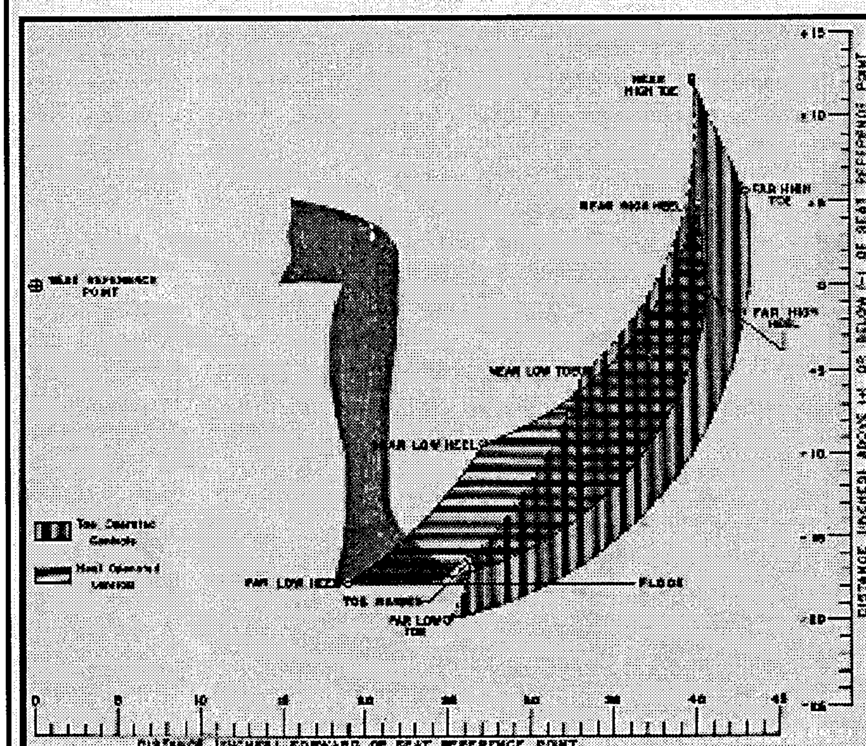
Hall, E. R., Modrick, J. A., Richard, P. R., & Moss, J. L. (1963). *The checkout and maintenance (CAM) Trainer: II. Description and functional characteristics* (AMRL Memorandum Report P-51). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 417 417)

Hall, I. A. M. (1958). *Effects of controlled element on the human pilot* (WADC Technical Report 57-509). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 130 979)

Hammer, L. R. (1961). *Aeronautical systems division studies in weightlessness: 1959 - 1960* (WADD Technical Report 60-715). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 273 098)

Hammer, L. R. (1962). *Perception of the visual vertical under reduced gravity* (MRL Technical Documentary Report 62-55). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC No. 284 050)

Hanavan, E. P., Jr. (1964). *A mathematical model of the human body* (AMRL Technical Report 64-102). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 608 463)



ANTHROPOMETRY OF WORKPLACE LAYOUT

A chart for foot-pedal activation by a seated operator. The chart is from a compilation of human engineering recommendations on various aspects of the layout of workplaces including general considerations, workplace dimensions, location of controls and displays, and direction of motion relationships. This report was prepared under Research and Development Project 7180, "Human Engineering Applications to Equipment Design" by Jerome H. Ely, Robert M. Thomson, and Jesse Orlansky. WADC-TR-56-171 (1956)

The Human Has Limitations

Engineering psychology began with the intellectual discovery that the human was not a perfectly adaptable organism. Of course, no one had ever formally asserted that the man was perfectly adaptable, but up until a few years ago the applied psychologist acted as if the human's flexibility were sufficient to make possible all important adjustments between man and his environment. We now know that this is not so. All of us are aware of how, during World War II, the approach of designing the task to fit the operator was added to the more traditional psychological procedures of selecting and training operators to fit their jobs. This was necessitated by the variety and complexity of military equipment. Machinery had finally outrun the man's ability to adapt. And the recognition of this fact was the first important insight in the development of engineering psychology.

— Franklin V. Taylor, 1960, "Four Basic Ideas in Engineering Psychology," The American Psychologist

Haneman, V. S., Jr., & Senders, J. W. (1955). *Correlation computation* (WADC Technical Report 55-197). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 80 941)

Hansen, R., Cornog, D., & Hertzberg, H. T. E. (1958). *Annotated bibliography of applied physical anthropology in human engineering* (WADC Technical Report 56-30). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 155 622)

Harris, C. S., Chiles, W. D., & Touchstone, R. M. (1964). *Human Performance as a function of intensity of vibration at 5 CPS* (AMRL Technical Documentary Report 64-83). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 607 760)

Harris, C. S., & Shoenberger, R. W. (1956). *Human performance during vibration* (AMRL Technical Report 65-204). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 624 196)

Harris, C. S., Thackray, R. I., & Shoenberger, R. W. (1956). *The relation of anxiety measurements and physiological indicants of arousal to the rate of blinking during induced muscular tension* (AMRL Technical Report 65-121). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 694 504)

Harshbarger, J. H., & Gill, A. T. (1964). *Development of techniques for evaluation of visual simulation equipment* (AMRL Technical Documentary Report 64-49). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 607 680)

Hart, E. M. (1961). *Effects of outer-space environment important to simulation of space vehicles* (ASD Technical Report 61-201). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 269 014)

Harter, G. A., & Gain, P. (1957). *An electronic target simulator for use with operational radar surveillance systems* (WADC Technical Report 57-277). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 261)

Henneman, R. H., & Matthews, T. L. (1955). *The influence of message length and distracting task complexity: The second of a series of reports on auditory and visual message presentation under distracting task conditions* (WADC Technical Report 54-145). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 88 329)

Henneman, R. H., & Outcalt, N. R. (1955). *The influence of setting cues on manual responses made to following-instructions messages: The ninth in a series of reports on "set" as a determiner of perceptual responses* (WADC Technical Report 54-365). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 90 893)

Henneman, R. H., Reid, L. S., & Long, E. R. (1955). *The influence of categorical cuing on the identification of visually distorted words selected from a logically organized population: The seventh in a series of reports on "set" as a determiner of perceptual responses* (WADC Technical Report 54-362). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 85 567)

Herrick, R. M., Adler, H. E., Coulson, J. E., & Howett, G. L. (1955). *The detection of separations between adjacent signals on a simulated PPI radar scope* (WADC Technical Report 55-424). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 102 535)

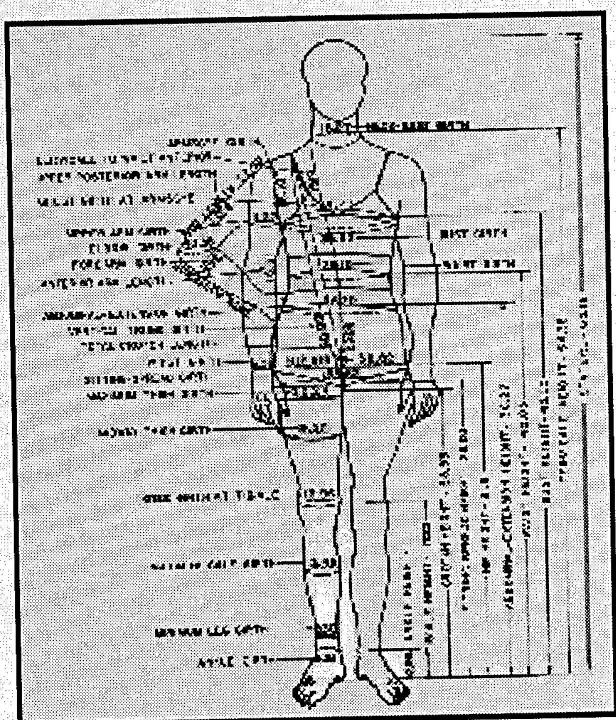
Hertzberg, H. T. E. (1955). Some contributions of applied physical anthropology to human engineering. *Annals of the New York Academy of Science, 63*, 616-629.

Hertzberg, H. T. E. (1959). Biomechanics of weightlessness. *Human Factors Magazine.*

Hertzberg, H. T. E. (1960). Dynamic anthropometry of working positions. *Human Factors Bulletin, 2.*

Hertzberg, H. T. E. (1960). *Some contributions of applied physical anthropology to human engineering* (WADC Technical Report 60-19). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 233 711)

Hertzberg, H. T. E. (1961). *Nylon net seat for a modified RB-57 Aircraft* (ASD Technical Report 61-206). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 280 049)



EXCERPT FROM AN APPLIED PHYSICAL ANTHROPOMETRY BIBLIOGRAPHY

Averages of 34 measurements on the adult female; taken from an annotated bibliography of 121 reports on applied physical anthropology in human engineering. The work was done by Robert Hansen, Douglas Y. Cornog, and H.T.E. Hertzberg. WADC-TR-56-30 (1958)

Hertzberg, H. T. E. et al. (1963). Anthropometric survey of Turkey, Greece and Italy. *AGARDograph 73.* Oxford, England: Pergamon Press.

Hertzberg, H. T. E., & Clauser, C. E. (1962). Size and motion. In P. Webb (Ed.), *NASA Life Sciences Data Book (1st ed.).* Yellow Springs, OH: Webb Associates.

Hertzberg, H. T. E., & Clauser, C. E. (1964). Size and motion. In P. Webb (Ed.), *Bio-Astronautics Data Book: Section 14.* Washington, DC: National Aeronautics and Space Administration. (NASA SP-30064)

Hertzberg, H. T. E., & Dupertuis, C. W. (1957). Stereophotogrammetry as an anthropometric tool. *Photogrammetric Engineering.*

Hertzberg, H. T. E., Dupertuis, C. W., & Emanuel, I. (1958). *Stereophotogrammetry as an anthropometric tool* (WADC Technical Report 58-67). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 150 964)

Hertzberg, H. T. E., Emanuel, I., & Alexander, M. (1956). *The anthropometry of working positions: A preliminary study* (WADC Technical Report 54-520). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 110 573)

Holland, J. G., & Lee, W. A. (1955). *The influence of message distortion and message familiarity: The third of a series of reports on auditory and visual message presentation under distracting task conditions* (WADC Technical Report 54-287). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 88 793)

Hopkins, C. O., Bauerschmidt, D. K., & Anderson, M. J. (1960). *Display and control requirements for manned space flight* (WADD Technical Report 60-197). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 242 572)

Hornseth, J. P., Huebner, W. J., & Pearson, W. H. (1963). *Control of a discrete stochastic process as a function of the costs for making corrective actions* (AMRL Technical Documentary Report 63-111). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 432 826)

Houston, R. C., & Green, M. R. (1957). *Training evaluation of an instrument panel homogeneous with respect to the principle of the moving part* (WADC Technical Report 57-551). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 142 241)

Howe, R. M. (1956). *Coordinate systems for solving the three dimensional flight equations* (WADC Technical Note 55-747). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 111 582)

Howe, R. M. (1957). *Final report, flight simulator theory study* (WADC Technical Report 58-456). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 211 768)

Howe, R. M. (1957). *An investigation of flight equation requirements for simulators of aircraft up to Mach 3.5* (WADC Technical Note 57-144). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 210 834)

Howe, R. M., & Gilbert, E. J. (1956). *A new resolving method for analog computers* (WADC Technical Note 55-468). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 111 581)

Howe, R. M., & Lemm, R. G. (1959). *A standardized computer for solving the three-dimensional flight equations* (WADC Technical Note 59-283). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 227 996)

VISUAL TRAINING PROCEDURES
Julien M. Christensen testing a subject with a tachistoscope which presented brief exposures of a display in an examination of visual training procedures to expand the visual field of trainees. WADC-TR-54-239

Howell, W., & Briggs, G. E. (1959). The effects of visual noise and locus of perturbation on tracking performance. *Journal of Experimental Psychology, 58,* 166-173.

Howell, W. C. (1962). On the heterogeneity of stimulus and response elements in the processing of information. *Journal of Experimental Psychology, 63,* 235-243.

Howell, W. C., Christy, R. T., & Kinkade, R. G. (1959). *System Performance following radar failure in a simulated air traffic control situation* (WADC Technical Report 59-573). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 234 011)

Howell, W. C., & Kraft, C. L. (1959). *Size, blur, and contrast as variables affecting the legibility of alpha-numeric symbols on radar-type displays* (WADC Technical Report 59-356). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 232 889)

Howell, W. C., & Kraft, C. L. (1961). The judgment of size, contrast, and sharpness of letter forms. *Journal of Experimental Psychology, 61,* 30-39.

Howell, W. C., & Kreidler, D. L. (1963). Information processing under contradictory instructional sets. *Journal of Experimental Psychology, 65,* 39-46.

Howell, W. C., Weizman, F., & Schrenk, L. P. (1963). *An evaluation of two variables contributing to the difficulty of a sequential decision task* (AMRL Technical Documentary Report 63-58). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 411 187)

Howland, D. (1958). *An investigation of the performance of the human monitor* (WADC Technical Note 57-431). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 43 066)

Huebner, W. J. (1963). *Error protected names* (AMRL Technical Documentary Report 63-83). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 430 714)

> **Most of the efforts of the Behavioral Sciences Laboratory are classified as applied research, i.e., research directed toward the solution of problems anticipated in future Air Force systems. Unless the research is aimed from 3 to 10 years into the future, it is likely to be too late by the time research is completed. Although identified as applied research, much of our research is planned so that it has general scientific value beyond the application to a particular Air Force problem.**
>
> *— March 1965, "Human Engineering and Training Research Division," Behavioral Sciences Laboratory*

Huebner, W. J., Jr., & Ryack, B. C. (1961). *Linear programming and workplace arrangements: Solution of assignment problems by the product technique* (WADD Technical Report 61-143). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 260 462)

Hunsicker, P. A. (1955). *Arm strength at selected degrees of elbow flexion* (WADC Technical Report 54-548). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 81 792)

Hunsicker, P. A. (1957). *A study of muscle forces and fatigue* (WADC Technical Report 57-586). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 131 087)

Hunt, D. P. (1959). *Tracking performance as a function of feedback specificity* (WADC Technical Report 58-584). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 212 3ll)

Hunt, D. P. (1961). The effect of the precision of informational feedback on human tracking performance. *Human Factors, 77*(3).

Hunt, D. P. (1962). *Decision making and stress* (MRL Memorandum Report P-7). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC No. 284 047)

Hunt, D. P. (1963). *The effects of curvilinear and discrete transformations of error information on human tracking performance* (AMRL Technical Documentary Report 63-137). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 432 707)

Hunt, D. P., & Warrick, M. J. (1957). *Accuracy of blind positioning of a rotary control* (WCLD Technical Note 52-106). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 142 291)

Hunt, D. P., & Zink, D. L. (1964). *Predecisional processes in decision making: Proceedings of a symposium* (AMRL Technical Documentary Report 64-77). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 613 180)

Hyman, A. (1960). *An apparatus for determining critical fusion frequencies and other psychophysical functions in vision* (WADD Technical Note 60-129). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 243 611)

Hyman, A. (1960). *Potential uses of alternate binocular presentation in studies of vision and as an indicator of physiological stress* (WADD Technical Report 60-302). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 245 184)

Hyman, A. (1963). Utilizing the visual environment in space. *Human Factors, 5*(3), 175-186.

Hyman, A., & Frew, J. (1961). Foveal brightness matches for stimuli differing in color. *Journal of the Optical Society of America, 5l*, 1459.

Iberall, A. S. (1964). *The use of lines of nonextension to improve mobility in full-pressure suits* (AMRL Technical Report 64-118). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 610 519)

Isakson, G. (1961). *Flight simulation of orbital and reentry vehicles: Part I. Development of equations of motion in six degrees of freedom* (ASD Technical Report 61-171(I)). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 269 282)

Isakson, G. (1961). *Flight simulation of orbital and reentry vehicles: IV. A study of earth oblateness effects and characteristic oscillatory motions of a lifting reentry vehicle* (ASD Technical Report 61-171(IV)). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 274 251)

As a student of Professor Fitts, I well remember his emphasis on rigor in research, on exhaustive inquiry, on plain hard work, his impatience with those who did not share his regard for these qualities, and his complete willingness to give unstintingly and unreservedly of his own ideas, assistance and time to any student who did. He was a firm but gentle and inspiring adviser.

— Julien Christensen, June 1965, "Paul M. Fitts Memorial Issue," Human Factors Society Bulletin

Isakson, G., & Bunning, H. (1960). *A study of problems in flight simulation of VTOL Aircraft* (WADC Technical Note 59-305). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 233 441)

Jahnke, J. C., Crannell, C. W., & Morrissette, J. O. (1964). Sex differences in the MAS. *Educational and Psychological Measurement, 24*(2).

Jeantheau, G. (1959). *The differential effects of speed and load stress on task performance* (WADC Technical Report 59-7). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 233 460)

Jenkins, W. L. (1957). *Mean least turn and its relation to making settings on a linear scale* (WADC Technical Report 57-210). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 174)

Jenkins, W. L. (1958). The superiority of gloved operation of small control knobs. *Journal of Applied Psychology, 24*, 97-98.

Jenkins, W. L., & Kar, A. C. (1955). *The influence of viewing distance in making settings on a linear scale* (WADC Technical Note 55-204). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 95 410)

Jerison, H. J. (1955). *Effect of a combination of noise and fatigue on a complex counting task* (WADC Technical Report 55-360). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 95 232)

Jerison, H. J. (1956). *Differential effects of noise and fatigue on a complex counting task* (WADC Technical Report 55-359). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 110 506)

Jerison, H. J. (1958). *Experiments on vigilance: Duration of vigil and the decrement function: Fourth in a series* (WADC Technical Report 58-369). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 155 722)

Jerison, H. J. (1959). Effects of noise on human performance. *Journal of Applied Psychology, 43*(2), 96-101.

Jerison, H. J. (1959). *Experiments on vigilance: The empirical model for human vigilance: Fifth in a series* (WADC Technical Report 58-526). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 202 883)

Jerison, H. J. (1963). Symposium on the decrement function in human vigilance. *PB Vigilance.* New York: McGraw-Hill.

Jerison, H. J., & Arginteanu, J. (1958). *Time judgments, acoustic noise, and judgment drift* (WADC Technical Report 57-454). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 130 963)

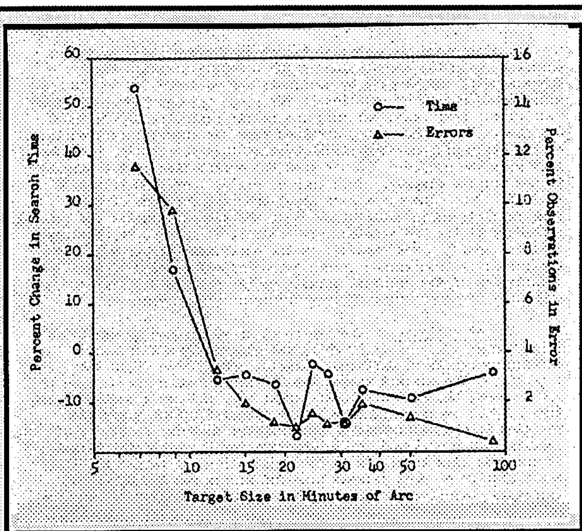
Jerison, H. J., Crannell, C. W., & Pownall, D. (1957). *Acoustic noise and repeated time judgments in a visual movement projection task* (WADC Technical Report 57-54). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 004)

Jerison, H. J., Crannell, C. W., & Pownall, D. (1958). Acoustic noise and time judgment in a visual movement project task. In G. Finch, & F. Cameron (Eds.), *Air Force Human Engineering, Personnel, and Training Research* (NAS-NRC Publication No. 516, pp. 147-154). Washington, DC: National Academy of Sciences-National Research Council.

Jerison, H. J., & Pickett, R. M. (1963). Vigilance: A review and re-evaluation. *The Journal of the Human Factors Society, 5*, 211-238.

Jerison, H. J., & Pickett, R. M. (1964). Vigilance: The importance of the elicited observing rate. *Science, 143*, 970-971.

Jerison, H. J., & Smith, A. K. (1955). *Effect of acoustic noise on time judgment* (WADC Technical Report 55-358). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 99 641)



TARGET DETECTION AS A FUNCTION OF TARGET ANGULAR SIZE

A graph of search time and errors as functions of angular target size in minutes of arc. This work was done under Task 71580, "Criteria for the Design and Arrangement of Displays," by William C. Steedman and Charles A. Baker. WADD-TR-60-93 (1960)

Jerison, H. J., & Wallis, R. A. (1957). *Experiments on vigilance: One-clock and three-clock monitoring: Second in a series* (WADC Technical Report 57-206). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 171)

Jerison, H. J., & Wallis, R. A. (1957). *Experiments on vigilance: Performance on a simple vigilance task in noise and in quiet: Third in a series* (WADC Technical Report 57-318). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 337)

Jerison, H. J., & Wing, J. F. (1961). Human vigilance and operant behavior. *Science, 133*, 880.

Jerison, H. J., & Wing, J. F. (1963). Human vigilance and operant behavior. *Vigilance, A Symposium* (pp. 34-43). New York: McGraw-Hill.

Jerison, H. J., & Wing, S. (1957). *Effects of noise and fatigue on a complex vigilance task* (WADC Technical Report 57-14). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 110 700)

Kama, W. N. (1961). *Effects of simulated weightlessness upon positioning responses* (ASD Technical Report 61-555). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 277 288)

Kama, W. N. (1961). *Speed and accuracy of positioning weightless objects as a function of mass, distance, and direction* (WADD Technical Report 61-182). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 267 247)

Kama, W. N. (1963). *Volumetric workspace study: I. Optimum workspace configuration for using various screwdrivers* (AMRL Technical Documentary Report 63-68(I)). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 420 353)

Kama, W. N. (1964). *Human factors in remote handling: A review of past and current research at the 6570th Aerospace Medical Research Laboratories* (AMRL Technical Report 64-122). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 610 732)

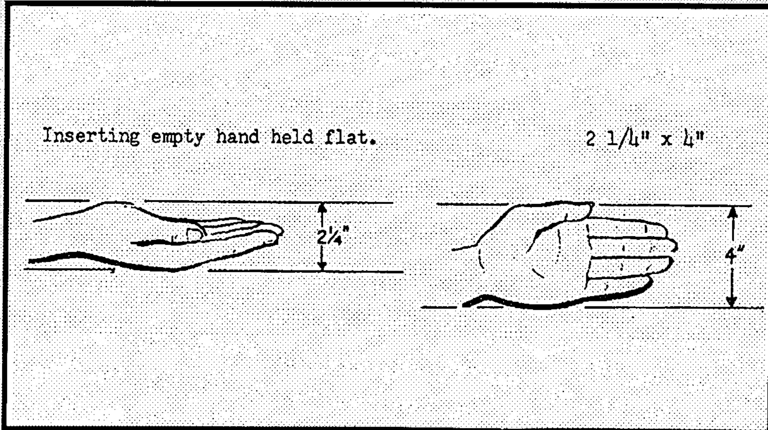
Kama, W. N., & DuMars, R. C. (1964). *Remote viewing: A comparison of direct viewing, 2D and 3D television* (AMRL Technical Documentary Report 64-15). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 436 015)

Kama, W. N., Pope, L. T., & Baker, D. F. (1964). *The use of auditory feedback in simple remote handling tasks* (Report No. AMRL-TDR-64-46). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Kamm, L. J., Sherertz, P. C., & Steffen, L. E. (1960). *An electronic two-variable function generator* (WADC Technical Report 59-546). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 236 964)

Kanareff, V. T., & Lanzetta, J. T. (1960). Effects of success-failure experiences and probability of reinforcement upon the acquisition and extinction of an imitative response. *Psychological Reports, 7*, 151.

Kanareff, V. T., & Lanzetta, J. T. (1960). Effects of task definition and probability of reinforcement upon the acquisition and extinction of imitative responses. *Journal of Experimental Psychology, 60*, 340.



EXCERPT FROM A GUIDE FOR DESIGN AND MAINTAINABILITY

Required size of an access opening for one-hand tasks from a design guide for maintainability containing recommendations on design practices for maximizing the ease with which electronic equipment can be maintained. The work was done by John D. Folley, Jr. and James W. Altman of the American Institute for Research. WADC-TR-56-218 (1956)

Kasten, D. F. (1962). *Human performance in a simulated short orbital transfer* (AMRL Technical Documentary Report 62-138). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 400 484)

Kasten, D. F. (1964). Interdisciplinary measurement of human performance under low and zero gravity conditions. *Proceedings of the 11th Annual Air Force Science and Engineering Symposium.*

Kellogg, R. S., Kennedy, R. S., & Graybiel, A. (1964). *Motion Sickness symptomatology of labyrinthine defective and normal subjects during zero gravity maneuvers* (AMRL Technical Documentary Report 64-47). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 603 339)

Kennedy, K. W. (1964). *Reach capability of the USAF population, phase I: The outer boundaries of grasping-reach envelopes for the shirt-sleeved, seated operator* (AMRL Technical Documentary Report 64-59). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 608 269)

Kidd, J. S. (1959). *A comparison of two methods of controller training in simulated air traffic control task: A study in human engineering aspects of radar air traffic control* (WADC Technical Report 58-449). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 212 269)

Kidd, J. S. (1959). *A summary of research methods, operator characteristics, and system design specifications based on the study of a simulated radar air traffic control system* (WADC Technical Report 59-236). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 235 126)

Kidd, J. S. (1961). A comparison of one-, two-, and three-man work units under various conditions of work load. *Journal of Applied Psychology, 45,* 195-200.

Kidd, J. S. (1961). *Some sources of load and constraints on operator performance in a simulated radar air traffic control task* (WADD Technical Report 60-612). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 255 232)

Kidd, J. S. (1962). Line noise and man-machine system performance. *Journal of Engineering Psychology, 1,* 13-18.

Kidd, J. S. (1962). A new look at system research and analysis. *Human Factors,* 209-216.

Kidd, J. S., & Christy, R. T. (1961). Supervisory procedures and work-team productivity. *Journal of Applied Psychology, 45,* 388-392.

Kidd, J. S., & Hooper, J. J. (1959). *Division of responsibility between two controllers and load balancing flexibility in a radar approach control team: A study in human engineering aspects of radar air traffic control* (WADC Technical Report 58-473). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 214 616)

Kidd, J. S., & Kinkade, R. G. (1958). *Air traffic control system effectiveness as a function of the division of responsibility between pilots and ground controllers: A study in human engineering aspects of radar air traffic control* (WADC Technical Report 58-113). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 151 082)

Kidd, J. S., & Kinkade, R. G. (1959). *Operator change-over effects in a complex task* (WADC Technical Report 59-235). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 234 778)

Kidd, J. S., & Kinkade, R. G. (1962). Operator change-over effects in a complex task. *Journal of Engineering Psychology,* 1, 82-91.

Kidd, J. S., Shelly, M. W., Jeantheau, G., & Fitts, P. M. (1958). *The effect of enroute flow control on terminal system performance: A study in human engineering aspects of radar air traffic control* (WADC Technical Report 57-663). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 142 096)

Kinkade, R. G. (1963). *A differential influence of augmented feedback on learning and on performance* (AMRL Technical Report 63-12). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 402 973)

Kinkade, R. G., & Kidd, J. S. (1959). *The effect of different proportions of monitored elements on operator performance in a simulated radar air traffic control system* (WADC Technical Report 55-169). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 227 420)

Kinkade, R. G., & Kidd, J. S. (1959). *The effect of procedural variations in the use of target identification and airborne position information equipment on the performance of a simulated radar approach control system* (WADC Technical Report 58-624). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 216 361)

Kinkade, R. G., & Kidd, J. S. (1959). *The effect of team size and intermember communication on decision-making performance* (WADC Technical Report 58-474). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 215 621)

Kinkade, R. G., & Kidd, J. S. (1962). The use of an operational game as a method of task familiarization. *Journal of Applied Psychology, 46,* 1-5.

Knowles, W. B. (1962). *Human engineering in remote handling* (AMRL Technical Documentary Report 62-58). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 287 529)

Kolers, P. A. (1958). *A multi-field electronic tachistoscope* (WADC Technical Note 58-349). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 208 320)

Kolers, P. A. (1960). *Some aspects of problem solving: 1. Method and materials* (WADD Technical Report 60-2). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 235 419)

Kolers, P. A. (1962). *Multi-field electronic apparatus for studies of visual perception* (MRL Technical Documentary Report 62-33). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC No. 283 943)

Kolers, P. A., & Rosner, B. S. (1960). On visual masking (matacontrast): Dichoptic observation. *American Journal of Psychology, 73,* 2-21.

Kolers, P. A., & Zink, D. L. (1962). *Some aspects of problem solving: Sequential analysis of the detection of embedded patterns* (AMRL Technical Documentary Report 62-148). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 400 310)

Kraft, C. L. (1956). *A broad band blue lighting system for radar approach control centers: Evaluations and refinements based on three years of operational use* (WADC Technical Report 56-71). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 090)

Kraft, C. L., & McGuire, J. C. (1958). *Suitability of the installation of the illumination system for the Experimental RAPCON Center* (WADC Technical Note 58-29). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 151 148)

Krasny, L. M. (1962). *The functional design of a special-purpose digital computer for real-time flight simulation* (MRL Technical Documentary Report 62-39). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC No. 283 099)

Kreezer, G. L. (1959). *Attention value of audio and visual warning signals* (WADC Technical Report 58-521). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 279 885)

Kris, E. C. (1958). *A technique for electrically recording eye position* (WADC Technical Report 58-660). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 209 385)

Krogman, W. M., & Johnston, F. E. (1963). *Human mechanics: Four monographs abridged* (AMRL Technical Documentary Report 63-123). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 600 618)

Kulwicki, P. V., & Peoples, G. (1962). *Control rotation and stabilization for the orbital worker* (AMRL Memorandum Report P-21). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 295 627)

Kulwicki, P. V., Schlei, E. J., & Vergamini, P. L. (1962). *Weightless man: Self-rotation techniques* (AMRL Technical Documentary Report 62-129). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 400 354)

Kurtzberg, J. M. (1963). *Dynamic task scheduling in flight simulators* (AMRL Technical Documentary Report 63-17). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 402 383)

Lanzetta, J. T., & Kanareff, V. T. (1960). *Some social factors affecting the choice of an "imitative" response in a probability learning situation* (WADD Technical Report 60-196). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 249 042)

Lanzetta, J. T., & Kanareff, V. T. (1962). Information cost, amount of payoff, and level of aspiration as determinants of information seeking in decision making. *Behavioral Science, 7*, 459.

Learner, D. B., & Alluisi, E. A. (1956). *Comparison of four methods of encoding elevation information with complex line-inclination symbols* (WADC Technical Note 56-485). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 110 547)

Lee, W. A., & Freitag, M. (1955). *The concept of response restriction applied to dial reading: The eighth of a series of reports on "set" as a determiner of perceptual responses* (WADC Technical Report 54-364). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 85 566)

Leibowitz, H. W. (1955). The relation between the rate threshold for the perception of movement and luminance for various durations of exposure. *Journal of Experimental Psychology, 49*, 209-214.

Levine, M., Senders, J. W., Morgan, R. L., & Doxtater, L. (1964). *Tracking performance as a function of exponential delay and learning* (AMRL Technical Report 64-104). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 609 811)

Lewis, A., & Kanareff, V. T. (1959). *Use of autocorrelation and uncertainty measures for the analysis of decision behavior* (WADC Technical Report 59-434). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 231 294)

SELECTING INSTRUMENT SCALES FOR READING EFFICIENCY

Testing for reading efficiency with various scale shapes, exposure times, and response complexities. This work, a part of the research on man-machine systems of the Aviation Psychology Branch, was done by Edwin H. Elkin of The Ohio State University. WADC-TR-58-472 (1959)

Lewis, T. S., & Huebner, W. J., Jr. (1964). *Error control methods for the automatic checkout system* (AMRL Technical Documentary Report 64-17). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 607 735)

Licklider, J. C. R. (1961). *Audio warning signals for Air Force systems* (WADD Technical Report 60-814). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 258 530)

Livingston, W. A., Jr. (1962). *Outer-space environment models for use with space vehicle simulators* (MRL Technical Documentary Report 62-40). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC No. 283 284)

Loftus, J. P., & Hammer, L. R. (1961). *Weightlessness and performance: A review of the literature* (ASD Technical Report 61-166). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 267 041)

Loftus, J. P., Jr. (1963). *Symposium on motion sickness with special reference to weightlessness* (AMRL Technical Documentary Report 63-25). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 412 818)

Long, E. R., & Garvey, W. D. (1955). *The influence of sensory channel of cuing on the identification of aurally presented distorted words: The sixth in a series of reports on "set" as a determiner of perceptual responses* (WADC Technical Report 54-361). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 85 565)

Long, E. R., & Garvey, W. D. (1955). *The role of setting cues in reducing the simultaneous location and identification ambiguity of letter patterns: The fifth of a series of reports on "set" as a determiner of perceptual responses* (WADC Technical Report 54-289). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 34 517)

Loret, B. J. (1961). *Optimization of manned orbital satellite vehicle design with respect to artificial gravity* (ASD Technical Report 61-688). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 277 446)

Losee, J. E., Allen, R. H., Stroud, J. W., & Ver Hulst, J. (1962). *A study of the Air Force maintenance technical data system* (AMRL Technical Documentary Report 62-85). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 288 636)

Lowder, R. G. (1959). *Considerations in prediction of maintainability* (WADC Technical Note 59-378). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 233 878)

Mangelsdorf, J. E. (1955). *Variables affecting the accuracy of collison judgments on radar-type displays* (WADC Technical Report 55-462). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 101 282)

McConnell, D., & Shelly, M. W. (1960). Tracking performance on a sequence of step functions which approaches a continuous function as a limit. *Journal of Experimental Psychology, 59,* 312-320.

McConville, J. T., & Alexander, M. (1963). *Anthropometric data in three-dimensional form: Development and fabrication of USAF height-weight manikins* (AMRL Technical Documentary Report 63-55). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 411 556)

McCoy, W. K., Jr., & Frost, G. G. (1964). *Time history as an information source for operator control of orbital rendezvous* (AMRL Technical Documentary Report 64-55). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 603 597)

McGuire, J. C. (1957). *Effect of traffic configurations on the accuracy of radar air traffic controller judgments* (WADC Technical Report 56-73). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 268)

McGuire, J. C., & Kraft, C. L. (1956). *Reaction of six radar air traffic controllers to conference control of targets simulated on a 19-inch horizontal display* (WADC Technical Note 56-542). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 110 692)

McGuire, J. C., & Kraft, C. L. (1956). *Reaction of ten radar air traffic controllers to operational use of the telex twin-microphone, boom-type, split headset* (WADC Technical Note 56-541). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 110 691)

McGuire, J. C., & Kraft, C. L. (1958). *A radio channel load distribution analyzer for use in studies of communication flow in radar approach control centers* (WADC Technical Note 57-424). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 142 243)

McKechnie, D. F., Self, H. C., & Van Ausdall, B. A. (1964). *Side-looking radar training materials for the 665A Program* (Report No. AFAMRL Memorandum P-64). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. 516-496)

McNulty, C. F. (1962). *Simulation techniques for spacecrew training: State-of-the-art review* (MRL Technical Documentary Report 62-32). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC No. 283 343)

McRuer, D. T., & Krendel, E. S. (1957). *Dynamic response of human operators* (WADC Technical Report 56-524). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 110 693)

Mengelkoch, R. F., & Houston, R. C. (1958). *Investigations of vertical displays of altitude information: I. Comparison of a moving-tape and standard altimeter on a simulated flight task* (WADC Technical Report 57-384). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 130 828)

Mengelkoch, R. F., & Houston, R. C. (1958). *Investigations of vertical displays of altitude information: II. The effect of practice on performance of a simulated flight task using a moving-tape altimeter* (WADC Technical Report 57-385). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 130 829)

Mengelkoch, R. F., & Houston, R. C. (1958). *Investigations of vertical displays of altitude information: III. The effect of an expanded scale on performance of a simulated flight task using a moving-tape altimeter* (WADC Technical Report 57-549). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 142 042)

Meyers, H. C., Daniels, G. S., Churchill, E., & Roelke, N. (1956). *Body dimension changes during basic training* (WADC Technical Report 56-458). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 97 216)

Middleton, R. H., Muick, C. J., Alexander, M., & Klemm, F. K. (1963). *Helmet visor defog capabilities and general evaluation of the G-2C-l space suit assembly* (Technical Memorandum SEM-TM-63-3). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Miller, E. F., Graybiel, A., Kellogg, R. S., & O'Donnell, R. D. (1959). *Motion sickness susceptibility under weightless and hypergravity conditions generated by parabolic flight* (NAMI-1057). Naval Aerospace Medical Center.

Miller, I., & Freund, J. E. (1961). *Investigation of spectral estimation* (ASD Technical Report 61-714). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 273 097)

Miller, L., & Lanzetta, J. T. (1962). Choice among equal expected value among equal alternatives: The influence of absolute winning probability level upon variance preferences. *American Psychologist, 17*, 368.

Morin, R. E., & Grant, D. A. (1955). Learning and performance on a key-pressing task as a function of the degree of spatial stimulus-response correspondence. *Journal of Experimental Psychology, 49*, 39-47.

Morrissette, J. O., Crannell, C. W., & Switzer, S. A. (1964). Group performance under various conditions and work load and informational redundancy. *The Journal of General Psychology, 71*, 337-347.

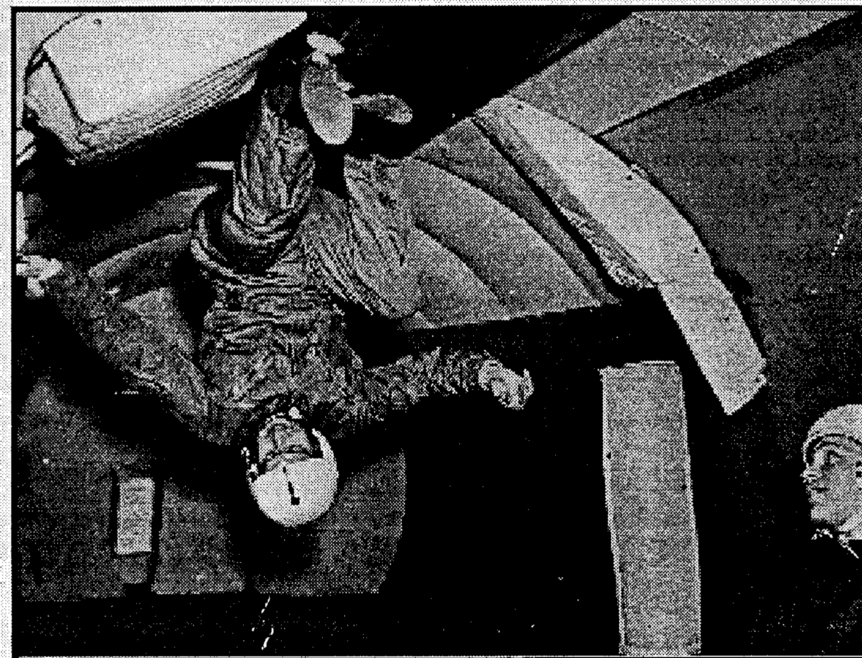
Morrissette, J. O., & Pearson, W. H. (1963). Prediction of behavior under conditions of uncertainty. *Journal of Experimental Psychology, 65*, 391-397.

Moss, S. M., Kraft, C. L., & Howell, W. C. (1961). *The influence of overlay configuration on the estimation of heading and speed* (WADD Technical Report 61-141). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 255 233)

Muckler, F. A. (1960). *Man-machine tracking performance with short-period oscillatory control system transients* (WADD Technical Report 60-3). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 236 939)

SUBJECTS IN ZERO GRAVITY IN AN AIRCRAFT

Test subjects floating in zero gravity in an aircraft in a flight path that produces zero gravity. These flights were designed to test the effects of weightlessness on the crew members of future vehicles in orbit around the earth. These tests, conducted by the Human Engineering Branch, were later continued and extended by NASA.



Muckler, F. A. (1961). *The design of operator controls: A selected bibliography* (WADD Technical Note 60-277). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 267 055)

Muckler, F. A., Obermayer, R. W., Hanlon, W. H., & Serio, F. P. (1961). *Transfer of training with simulated aircraft dynamics: II. Variations in control gain and phugoid characteristics* (WADD Technical Report 60-615(II)). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 278 613)

Muckler, F. A., Obermayer, R. W., Hanlon, W. H., & Serio, F. P. (1961). *Transfer of training with simulated aircraft dynamics: III. Variations in course complexity and amplitude* (WADD Technical Report 60-615(III)). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 278 623)

Muckler, F. A., Obermayer, R. W., Hanlon, W. H., Serio, F. P., & Rockway, M. R. (1961). *Transfer of training with simulated aircraft dynamics: I. Variations in period and damping of the phugoid response* (WADD Technical Report 60-615(I)). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 278 627)

Mueller, D. D. (1962). *An analysis of the behavior of long tetherlines in space* (AMRL Technical Documentary Report 62-123). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 293 222)

Mueller, D. D. (1962). *The coriolis effect in zero-gravity research aircraft* (MRL Memorandum Report P-9). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC No. 284 049)

Mueller, D. D. (1962). *Relative motion in the docking phase of orbital rendezvous* (AMRL Technical Documentary Report 62-124). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 402 384)

Mueller, D. D. (1963). *Zero-gravity indoctrination for the Gemini/Apollo astronauts* (AMRL Memorandum Report P-31). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 402 786)

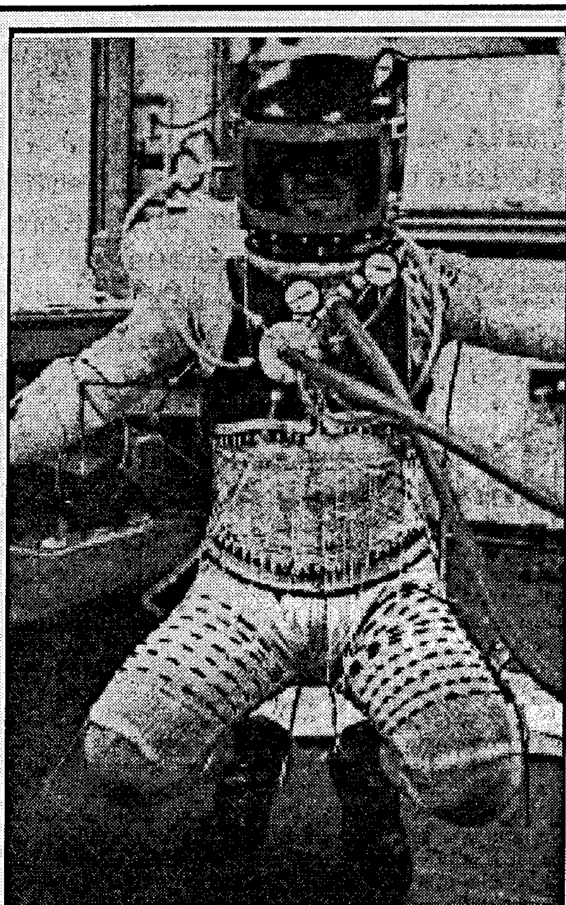
Mueller, D. D. (1964). *Man's vertical acceleration while crouching* (AMRL Technical Documentary Report 64-56). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 607 044)

Mueller, D. D., & Simons, J. C. (1962). *Weightless man: Single-impulse trajectories for orbital workers* (AMRL Technical Documentary Report 62-103). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 289 257)

Muller, P. F., Jr. (1955). *Efficiency of verbal versus motor responses in handling information encoded by means of colors and light patterns* (WADC Technical Report 55-472). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 107 260)

Muller, P. F., Jr., Sidorsky, R. C., Slivinske, A. J., Alluisi, E. A., & Fitts, P. M. (1955). *The symbolic coding of information on cathode ray tubes and similar displays* (WADC Technical Report 55-375). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 103 239)

Narva, M. A. (1958). *Evaluation of decision making performance on three pictorial navigation displays* (WADC Technical Report 58-49). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 142 329)



KNEE BENDS IN A PARTIAL PRESSURE SUIT

A subject performing deep knee bends in a full-pressure suit in a study to obtain data for designing pressure suits that could provide natural mobility and minimal ballooning. The work was done under Task 718408, "Anthropology for Design" by Author S. Iberall of the Rand Development Corporation. AMRL-TR-64-118 (1964)

Narva, M. A., Gainer, C. A., & Muckler, F. A. (1960). *Integrated instruments: Information requirements for fuel management* (WADD Technical Report 60-638). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 252 053)

Naylor, J. C., & Briggs, G. E. (1963). Effect of rehearsal of temporal and spatial aspects on the long-term retention of a procedural skill. *Journal of Applied Psychology, 47,* 120-126.

Naylor, J. C., Briggs, G. E., Brown, D. R., & Reed, W. G. (1963). *The effect of rehearsal on the retention of a time-shared task* (AMRL Technical Documentary Report 63-33). Wright-Pat-terson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 408 554)

Nicholson, J. F., & Naas, D. W. (1960). *Magnetic shoes for human orientation in space* (WADC Technical Note 59-352). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 236 362)

Nicklas, D. R. (1958). *A history of aircraft cockpit instrumentation 1903-1946* (WADC Technical Report 57-301). Wright-Patterson AFB, OH: Wright Air Development Center.

Nygaard, J. E., Slocum, G. K., Thomas, J. O., Skeen, J. R., & Woodhull, J. G. (1964). *The measurement of stimulus complexity in high-resolution sensor imagery* (AMRL Technical Documentary Report 64-29). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 603 007)

Obermayer, R. W., Swartz, W. F., & Muckler, F. A. (1961). The interaction of information displays with control system dynamics in continuous tracking. *Journal of Applied Psychology, 45*(6), 369-375.

Ormiston, D. W. (1961). *A methodological study of confinement* (WADD Technical Report 61-258). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 266 211)

Ormiston, D. W., & Finkelstein, B. (1961). *The effects of confinement on intellectual and perceptual functioning* (ASD Technical Report 61-577). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 272 181)

> **"The most important and satisfying work I was involved with was the development and implementation of the Human Engineering System Simulator. It was based on an IBM 360-40 and was the first system that allowed us to do multi-operator simulation research. At that time we had a requirement to do command and control studies involving systems like the AWACS. The facility was constantly threatened by the base Computer Center, who felt that a laboratory should not have such a large computer facility. I spent a lot of time convincing them that it was a research facility rather than a data processing facility. There was no other facility like it at that time. We did a lot of good research during those years."**
>
> *— Don Topmiller, Chief*
> *Systems Engineering Branch*
> *Human Engineering Division*

Ormiston, D. W., Rohles, F. H., Jr., & Grunzke, M. E. (1959). *A device for measuring gross motor behavior in primates* (WADC Technical Note 59-353). Wright-Patterson AFB, OH: Wright Air Development Center.

Parker, J. F., Jr., & Fleishman, E. A. (1959). *Prediction of advanced levels of proficiency in a complex tracking task* (WADC Technical Report 59-255). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 236 907)

Pearson, W. H. (1962). *Effect of variation of the drift parameters on control of a stochastic process* (MRL Technical Documentary Report 62-72). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC No. 292 144)

Perry, E. L. (1962). *Submicrosecond simulation computer study program: I. Requirements for techniques study* (MRL Technical Documentary Report 62-27(I)). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC No. 278 848)

Perry, E. L. (1962). *Submicrosecond simulation computer study program: Preliminary design and system synthesis* (MRL Technical Documentary Report 62-27(II)). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC No. 290 628)

Pickett, R. M. (1964). The perception of a visual texture. *Journal of Experimental Psychology, 68*, 13-20.

Pigg, L. D. (1961). *Human engineering principles of design for in-space maintenance* (ASD Technical Report 61-629). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 271 066)

Pigg, L. D., & Kama, W. N. (1961). *The effect of transient weightlessness on visual acuity* (WADD Technical Report 61-184). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 261 906)

Pigg, L. D., & Kama, W. N. (1962). *Visual acuity in relation to body orientation and G-Vector* (MRL Technical Documentary Report 62-74). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC No. 285 552)

Pinkernell, H. (1960). *Flight path recorder* (WADD Technical Note 60-4). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 243 928)

Platzer, H. L. (1955). *The phase-plane as a tool for the study of human behavior in tracking problems* (WADC Technical Report 55-444). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 95 758)

Pope, L. T. (1961). *A survey of checkout equipment used in Air Force weapon systems, with emphasis on the man-machine relationship* (ASD Technical Note 61-38). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 262 166)

Pope, L. T. (1962). *Attention level and visual and auditory monitoring performance* (AMRL Technical Documentary Report 62-97). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 291 951)

Pope, L. T. (1962). *Maintainability research* (MRL Memorandum Report P-5). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory.

Pope, L. T., & McKechnie, D. F. (1963). *Correlation between visual and auditory vigilance performance* (AMRL Technical Documentary Report 63-57). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 417 176)

Rasmussen, S. B. (1960). *Analog function generator* (WADC TR 59-439). Wright-Patterson AFB, OH: Wright Air Development Center.

Ray, J. T., Martin, O. E., Jr., & Alluisi, E. A. (1961). *Human performance as a function of the work-rest cycle* (NAS-NRC Publication 882). Washington, DC: National Academy of Science.

Rees, D. W. (1959). *Guide to design of Air Force check-list publications* (WADC Technical Report 59-758). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 235 418)

Rees, D. W., & Copeland, N. K. (1959). *The effects of serial position in check-list design* (WADC Technical Report 59-552). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 231 990)

Rees, D. W., & Copeland, N. K. (1960). *Discrimination of differences in mass of weightless objects* (WADD Technical Report 60-601). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 252 161)

Rees, D. W., & Kama, W. N. (1959). *Size of tabs: A factor in handling of guides and check-lists* (WADC Technical Report 59-158). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 213 595)

Reid, L. S., & Holland, J. G. (1955). *The influence of complex task variables on the relative efficiency of auditory and visual message presentation: The fourth of a series of reports on an experimental analysis of complex task performance* (WADC Technical Report 54-288). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 88 065)

"I got interested in the study of models used to estimate the total body moments of inertia and body part moments of inertia. We did not have computer models back then. I developed a wooden model that represented—at least mathematically—those parameters. That led to further development in the area of mass distribution characteristics of the human body. This information was important for predicting how the body would respond when in motion, or to changes in motion. NASA, of course, had a tremendous interest in this, so they funded a project I had proposed to expand and improve the data. We collected the measurements from cadavers, using the facilities at FAA Civil Aeromedical Institute in Oklahoma City—probably the best anatomy lab outside of the universities. Measurements of volume, mass, and center of mass for various body parts were collected. We then prepared regression equations from the data. A lot of those equations are still being used today."

— Charles Clauser, Anthropologist
Human Engineering Division

Rhodes, F., Jr. (1964). *Predicting the difficulty of locating targets from judgments of image characteristics* (AMRL Technical Documentary Report 64-19). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 601 375)

Rhodes, F., & Self, H. C. (1964). *The effect of direction and speed of image motion upon target detection with side-looking radar* (AMRL Technical Documentary Report 64-45). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 603 598)

Richard, P. R., Moss, J. L., & Hall, E. R. (1963). *The checkout and maintenance (CAM) trainer: III. Malfunction simulator* (AMRL Memorandum Report P-62). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 431 852)

Rigby, L. V., & Cooper, J. I. (1961). *Problems and procedures in maintainability* (ASD Technical Note 61-126). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC 273 108)

Rigby, L. V., Cooper, J. I., & Spickard, W. A. (1961). *Guide to integrated system design for maintainability* (ASD Technical Report 61-424). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 271 477)

Ritchie, M. L. (1955). *Integrated instruments: A drag indicator* (WADC Technical Report 55-423). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 93 861)

Ritchie, M. L., & Bamford, H. E., Jr. (1957). *The effect upon the output of a complex man-machine system of quickening and damping a derivative feedback display* (WADC Technical Report 57-103). Wright-Patterson AFB, OH: Wright Air Dev. Center. (DTIC No. 118 069)

Ritchie, M. L., & Bamford, H. E., Jr. (1957). Quickening and damping a feedback display. *Journal of Applied Psychology, 41*, 395-402.

Ritchie, M. L., & Baker, C. A. (1957). *Psychological aspects of cockpit design - A symposium report* (WADC Technical Report 57-117). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 079)

Roberts, J. F. (1963). *Walking responses under lunar and low gravity conditions* (AMRL Technical Documentary Report 63-112). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 426 837)

Rockway, M. R. (1957). *Effects of variations in control deadspace and gain on tracking performance* (WADC Technical Report 57-326). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 347)

Rockway, M. R., & Franks, P. E. (1959). *Effects of variations in control backlash and gain on tracking performance* (WADC Technical Report 58-553). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 250 537)

Rohles, F. H., Jr., & Coy, R. (1959). *A miniaturized operant conditioning chamber for the behavioral research in the upper atmosphere* (WADC Technical Note 59-261). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 231 285)

Rohles, F. H., Jr., & Grunzke, M. E. (1959). *Sustained operant behavior in mice: A model for behavioral research in biosatellites* (WADC Technical Note 59-299). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 229 457)

Ross, D. A. (1959). *Comprehensibility evaluation of technical manuals* (WADC Technical Note 59-442). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 228 235)

Rudov, M. H. (1964). *Pilot aircraft aiming performance* (AMRL Technical Report 64-87). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

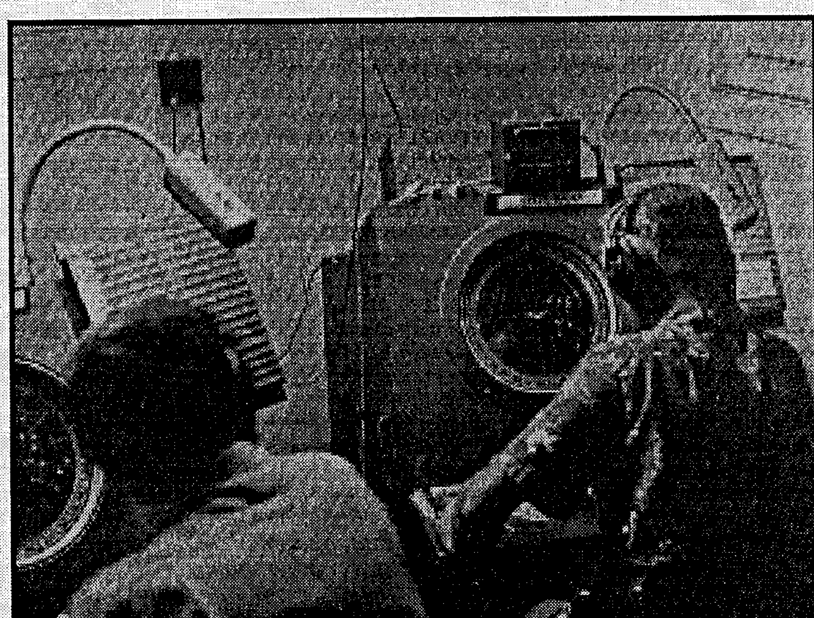
Sabeh, R., Jorve, W. R., & Vanderplas, J. M. (1958). *Shape coding of aircraft instrument zone markings* (WADC Technical Note 57-260). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 343)

Samson, R. L., & Zhaner, C. F. (1958). *Programming techniques for communication navigation facilities* (WADC Technical Note 58-315). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 229 674)

Santschi, W. R., Dubois, J., & Omoto, C. (1963). *Moments of inertia and centers of gravity of the living human body* (AMRL Technical Documentary Report 63-36). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 410 451)

Sasaki, E. H. (1963). *Effect of transient weightlessness on binocular depth perception* (AMRL Technical Documentary Report 63-134). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 432 802)

Sasaki, E. H. (1964). *Donning and doffing the "Phase B" apollo prototype space suit during zero gravity* (AMRL Technical Documentary Report 64-32). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 601 250)



BROAD-BAND BLUE LIGHTING FOR CONTROL ROOMS

Evaluating a broad-band blue lighting system for radar approach control centers (RAPCON) to assist in developing such a system as part of the research on human engineering problems of air traffic control. This work was carried out by Conrad L. Kraft of The Ohio State University. WADC-TR-56-71 (1956)

Schafer, T., Benson, N., & Clausen, H. (1961). *Development of criteria and quantitative predictors of maintainability of Air Force equipment* (ASD Technical Report 61-502). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 268 599)

Schelhorn, A. E. (1959). *A study of the dynamic response characteristics of flight simulators* (WADC Technical Report 59-98). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 210 566)

Schipper, L. M. (1955). *Prediction of critical events in contexts of different numbers of alternative events* (WADC Technical Note 55-744). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 97 631)

Schipper, L. M. (1956). Prediction of critical events in contexts of different numbers of alternative events. *Journal of Experimental Psychology, 52,* 377-389.

Schipper, L. M., Kidd, J. S., Shelly, M. W., & Smode, A. F. (1957). *Terminal system effectiveness as a function of the method by controllers to obtain altitude information: A study in human engineering aspects of radar air traffic control* (WADC Technical Report 57-278). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 267)

Schipper, L. M., Kraft, C. L., Smode, A. F., & Fitts, P. M. (1957). *The use of displays showing identity versus no-identity: A study in human engineering aspects of radar air traffic control* (WADC Technical Report 57-21). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 110 713)

Schipper, L. M., & Versace, J. (1956). *Human Engineering aspects of radar air traffic control: I. Performance in sequencing aircraft for landings as a function of control time availability* (WADC Technical Report 56-67). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 106 758)

Schipper, L. M., & Versace, J. (1956). *Predictions of arrival sequences of simulated radar targets as a function of display size, and target sharpness* (WADC Technical Report 56-72). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 275)

Schipper, L. M., Versace, J., Kraft, C. L., & McGuire, J. C. (1956). *Human engineering aspects of radar air traffic control: II. and III. Experimental evaluations of two improved identification systems under high density traffic conditions* (WADC Technical Report 56-68). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 110 527)

Schipper, L. M., Versace, J., Kraft, C. L., & McGuire, J. C. (1956). *Human engineering aspects of radar air traffic control: IV. A comparison of sector and in-line control procedures* (WADC Technical Report 56-69). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 110 528)

Schlei, E. J., & Vergamini, P. L. (1962). *Some motion characteristics of tethered free-floating workers* (AMRL Memorandum Report P-13). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 288 045)

Schwartz, N. F. (1961). *A game theory apparatus for psychological research* (ASD Technical Report 61-239). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 265 389)

Schwartz, N. F. (1961). *A pulse function, single axis, compensatory tracking apparatus* (ASD Technical Report 61-374). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 276 201)

Seaford, H. W., Jr. (1958). Comments on the photometric system. *American Journal of Physical Anthropology, 17,* 83-85.

Sears, C. W., & Bunch, E. P. (1963). *Modifications to ASD weightless aircraft, C-131B serial number 53-7806* (AMRL Memorandum Report P-41). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC 417 439)

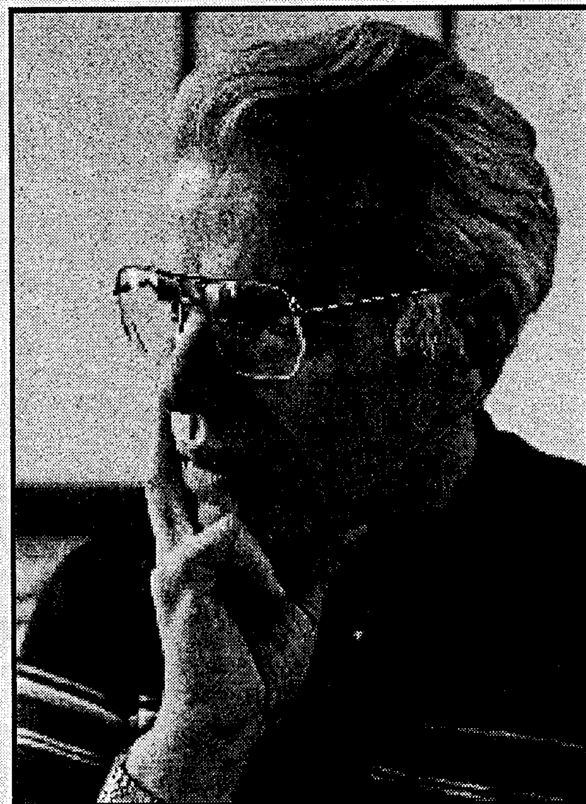
Seckel, E., Hall, I. A. M., McRuer, D. T., & Weir, D. H. (1958). *Human pilot dynamic response in flight and simulator* (WADC Technical Report 57-520). Wright-Patterson AFB, OH: Wright Air Development Center. (130 988)

Seeger, C. M. (1955). *Suitability of the MA-1 signal generator - auditory warning signal for use in USAF Aircraft Headsets* (WCRD Technical Memorandum Report 55-37). Wright-Patterson AFB, OH: Wright Air Development Center.

Colonel John C. Simons

Researcher
Human Engineering Division

1956 to 1966
1968 to 1971



John Simons was one of the most prolific and creative minds ever assigned to the Human Engineering Division of the Aero Medical Laboratory (now Armstrong Laboratory).

His contributions span four decades as a soldier, scientist, engineer and leader. Early on, Capt Simons was an important contributor to the Aero Medical Laboratory's partial role in the Mercury Space Program. He was one of the principals responsible for development of the parabolic flight trajectory used to simulate "zero-G" for engineering and astronaut training. Zero-G testing included such things as hydraulics, space locomotion, and human and animal physiological response. Variations of the parabolic flight profile are still used today by NASA in their C-135 zero-G aircraft.

Another notable achievement by Capt Simons was the development of the Long Lines personnel extraction system. It had long been understood that an aircraft flying a coordinated "pylon" turn could lower a cable which at the pylon turn point would hang stationary. This quirk of physics was exploited to recover personnel from behind enemy lines. The Long Lines system was tested with both mannequins and human volunteers and was operationally deployed. Although later supplanted by the Fulton extraction system, the Long Lines system pioneered the concept of rescue by fixed-wing aircraft.

As a major, Simons flew combat in his third war, Vietnam, with the famous 1st Air Commando Unit. Wounded in combat, he convinced the doctors to let him convalesce in Dayton. His first day back in the country, he appeared on crutches in the laboratory and eagerly passed his new combat experience to his fellow scientists and engineers.

The most important idea to emerge was the lateral firing gun. Again employing the pylon turn, lateral firing ordnance could be aimed with extraordinary accuracy. Upon his reassignment to the laboratory as a branch chief, Simons doggedly pursued the idea and eventually wangled a briefing to the Chief of Staff, then General Curtis LeMay. Gen LeMay was convinced and ordered that the prototype for what would become the AC-47 be built and tested at the Eglin AFB range. The tests were so successful that the aircraft was flown directly to Vietnam and immediately deployed in combat. John Simons is credited as co-inventor of the "gunship" which has served so successfully in Vietnam, Grenada, Panama, Iraq and Somalia.

John Simons continued to make creative contributions to the Human Engineering Division as a contractor after his retirement. His last contribution, one of the original 1968 combat-born ideas, was the Sensor Platform Imagery (SPI). SPI is a real-time reconnaissance drone which allows strike air crews to review the target minutes before they attack. A laboratory simulation completed in 1993 confirmed the effectiveness of SPI more than 20 years after the original Simons idea.

The creative genius of John Simons is a tribute to the soldier-scientist. The unique combination of master's degree, flying knowledge, combat experience, and a dedicated Air Force laboratory environment turned his creativity into exceptional productivity.

Seeger, C. M., Warrick, M. J., & Lacey, R. J. (1955). *Human engineering suitability evaluation of F-100A* (WADC Technical Note 55-598). Wright-Patterson AFB, OH: Wright Air Development Center.

Self, H. C. (1964). *The effects of direction and speed motion upon target detection with side-looking radar* (Report No. AFARML-TR-64-65). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Self, H. C., & Rhodes, F. (1964). *The effect of simulated aircraft speed on detecting and identifying targets from side-looking radar imagery* (AMRL Technical Documentary Report 64-40). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 603 014)

Seltzer, L. J., & McRuer, D. T. (1959). *Survey of analog cross-spectral analyzers* (WADC TR 59-241). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 236 025)

TESTING FINGER DEXTERITY WHILE WEARING A PRESSURE SUIT

A pressure-suited subject being tested with the Purdue Pegboard Dexterity Test for finger dexterity in a study to establish an objective baseline for evaluating the functional mobility of pressure gloves. This study was done under Task 718408, Anthropometry for Design by Dieter E. Walk. AMRL-TR-64-41 (1964)

Senders, J., Webb, I. B., & Baker, C. A. (1955). The peripheral viewing of dials. *Journal of Applied Psychology, 39*, 433-436.

Senders, J. W. (1955). *Tracking with intermittently illuminated displays* (WADC Technical Report 55-378). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 100 695)

Senders, J. W. (1959). *Survey of human dynamics data and a sample application* (WADC Technical Report 59-712). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 234 002)

Senders, J. W., & Bradley, J. V. (1956). *Effect of backlash on manual control of pitch of a simulated aircraft* (WADC Technical Report 56-107). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 95 404)

Senders, J. W., Christensen, J. M., & Sabeh, R. (1955). *Comparisons of a single operator's performance with team performance on a tracking task* (WADC Technical Note 55-362). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 96 355)

Senders, V. L., & Cohen, J. (1954). *The effects of absolute and conditional probability distributions of instrument settings on scale reading: Repeated exposures of the same setting* (WADC Technical Report 54-253). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 95 233)

Senders, V. L., & Cohen, J. (1955). Effects of sequential dependencies on instrument-reading performance. *Journal of Experimental Psychology, 50*, 66-74.

Senders, V. L., Cohen, J., & Arginteanu, J. (1955). *The effects of absolute and conditional probability distributions on instrument reading: II. A comparison of linear and a logarithmic scale* (WADC Technical Report 54-253(II)). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 95 233)

Shapero, A., & Bates, C., Jr. (1959). *A method for performing human engineering analysis of weapon systems* (WADC Technical Report 59-784). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 235 920)

Shapero, A., Cooper, J. I., Rappaport, M., Schaeffer, K. H., & Bates, C., Jr. (1960). *Human engineering testing and malfunction data collection in weapon system test programs* (WADD Technical Report 60-36). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 235 420)

Sharp, E., & Sears, C. W. (1963). *Walking under zero-gravity conditions using Velcro material* (AMRL Memorandum Report P-23). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 297 343)

Sharp, E. D. (1962). *Maximum torque exertable on knobs of various sizes and rim surfaces* (AMRL Technical Documentary Report 62-17). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 283 347)

Sharp, E. D. (1964). *A comparison of three full-pressure suits in terms of control activation time* (AMRL Technical Report 64-126). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 613 597)

Sharp, E. D., & Bowen, J. H. (1960). *An exploratory investigation of the effects of wearing full-pressure suits on control operation time* (WADD Technical Note 60-90). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 244 889)

Sidowski, J. B., Morgan, R. L., & Eckstrand, G. A. (1958). Influence of task complexity and instructions upon simple and discrimination reaction times. *Journal of Experimental Psychology, 55*, 163-166.

Simons, J. C. (1959). *Walking under zero-gravity conditions* (WADC Technical Note 59-327). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 232 469)

Simons, J. C. (1964). Introduction to surface free behavior. *Ergonomics, 7*(1).

Simons, J. C., & Gardner, M. S. (1960). *Self-maneuvering for the orbital worker* (WADD Technical Report 60-748). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 252 125)

Simons, J. C., & Gardner, M. S. (1963). *Weightless man: A survey of sensations and performance while free-floating* (AMRL Technical Report 62-114). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 410 767)

Simons, J. C., & Kama, W. N. (1963). *A review of the effects of weightlessness on selected human motions and sensations* (AMRL Memorandum Report P-36). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Simons, J. C., & Richardson, W. H. (1958). *Airborne equipment for recording aircraft flight paths* (WADC Technical Note 58-37). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 131 058)

Southard, J. F., Schum, D. A., & Briggs, G. E. (1964). *An application of Bayes Theorem as a hypothesis-selection aid in complex information-processing system* (AMRL Technical Documentary Report 64-51). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 607 256)

Southard, J. F., Schum, D. A., & Briggs, G. E. (1964). *Subject control over a Bayesian hypothesis-selection aid in a complex information-processing system* (AMRL TR 64-95). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 608 108)

Spragg, S. D. S., & Wulfeck, J. W. (1955). The effect of immediately preceding task brightness on visual performance. *Journal of Applied Psychology, 39*, 237-243.

Steedman, W. C., & Baker, C. A. (1960). *Target size and visual recognition* (WADD Technical Report 60-93). Wright-Patterson AFB, OH: Wright Air Dev Division. (DTIC No. 235 129)

Steedman, W. C., & Baker, C. A. (1962). Perceived movement in depth as a function of stimulus size. *Human Factors, 4*, 19-24.

Switzer, S. A. (1962). *Weight-lifting capabilities of a selected sample of human males* (AMRL Technical Documentary Report 62-57). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 284 054)

Tate, J. D., & Howell, W. C. (1963). *Term expectation and uncertainty in human decision behavior* (AMRL Technical Documentary Report 63-118). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC 431 634)

ASTRONAUTS, AIRCREW MEMBERS, AND EXPERIMENTERS
Participation in zero gravity flights conducted to determine effects on humans and their performance in space.

Thackray, R. I. (1962). *The measurement of activation level in stress research* (MRL Memorandum Report P-8). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC No. 284 048)

Thomas, R. E. (1962). *Development of new techniques for analysis of human controller dynamics* (MRL Technical Documentary Report 62-65). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC No. 283 826)

Thomas, R. E., & Pritsker, A. B. (1962). Decision programming: A model of man-machine control. *IRE Transactions of the Professional Group on Human Factors in Electronics.*

Thomas, R. E., Pritsker, A. B. A., Christner, C. A., Byers, R. H., & Huebner, W. J. (1961). *The effects of various levels of automation on human operators' performance in man-machine systems* (WADD Technical Report 60-618). Wright-Patterson AFB, OH: Wright Air Development Division.

Topmiller, D. A. (1963). *Defining "level-of-automation" for checkout equipment: A scaling approach* (AMRL Technical Documentary Report 63-76). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 420 577)

Topmiller, D. A. (1964). *A factor analytic approach to human engineering analysis and prediction of system maintainability* (AMRL TR 64-115). Wright-Patterson AFB, OH: Aerospace Medical Research Lab. (DTIC No. 610 210)

Topmiller, D. A., Griswold, G. H., & Aume, N. M. (1964). *Maintainability prediction for airborne electronic equipment* (AMRL Memorandum P-83). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Van Ausdall, B. A., & Self, H. C. (1964). *Effects of display polarity on target detection with side-looking radar* (AMRL Technical Report 64-82). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 609 246)

Van Buskirk, R. C., & Huebner, W. J. (1962). *Human-initiated malfunctions and system performance evaluation* (AMRL Technical Documentary Report 62-105). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 289 036)

Van Cott, H. P., & Altman, J. W. (1956). *Procedures for including human engineering factors in the development of weapon systems* (WADC Technical Report 56-488). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 97 305)

Vanderplas, J. M., Debons, A., & Crannell, C. W. (1959). *Luminance and "expectancy" as determinants of response time to a light signal* (WADC Technical Note 58-292). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 209 390)

Versace, J. (1956). *The effect of emergencies and communications availability with differing entry rates: A study in human engineering aspects of radar air traffic control* (WADC Technical Report 56-70). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 118 320)

Vicinus, J. H. (1962). *X-Ray anthropometry of the hand* (AMRL Technical Documentary Report 62-111). Wright-Patterson AFB, OH: Aerospace Medical Research Lab. (DTIC No. 291 412)

Wade, J. E. (1962). *Psychomotor performance under conditions of weightlessness* (MRL Technical Documentary Report 62-73). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC No. 285 549)

Waggoner, C. E., & Nixon, C. W. (1962). *Selected speech during weightlessness* (MRL TR 62-45). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC 284 688)

Walk, D. E. (1964). *Finger dexterity of the pressure-suited subject* (AMRL Technical Documentary Report 64-41). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 603 705)

Warrick, M. J. (1955). *Effect of exponential type control lags on the speed and accuracy of positioning a visual indicator* (WADC Technical Note 55-348). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 99 520)

Warrick, M. J., & Turner, L. (1963). *Simultaneous activation of bimanual controls* (AMRL Technical Documentary Report 63-6). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 403 381)

Weiss, R. (1963). *Display systems for sub- and zero-gravity flights* (AMRL Technical Documentary Report 63-11). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 402 382)

Welch, J. C., & McKechnie, D. F. (1964). *A preliminary study of the effects of briefing levels on reconnaissance performance with side-looking radar* (AMRL Technical Report 64-101). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 608 887)

White, W. J. (1964). *The effects of transient weightlessness on brightness discrimination* (AMRL Technical Documentary Report 64-12). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 435 544)

White, W. J., & Jorve, W. R. (1956). *The effects of gravitational stress upon visual acuity* (WADC Technical Report 56-247). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 110 444)

White, W. J., & Riley, M. B. (1958). *The effects of positive acceleration on the relation between illumination and instrument reading* (WADC Technical Report 58-332). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 206 663)

Whitsett, C. E. (1963). *Some dynamic response characteristics of weightless man* (AMRL Technical Documentary Report 63-18). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 412 541)

Wiegand, K. L. (1963). *Information theory and human behavior: Uncertainty as a fundamental variable in information-processing tasks* (AMRL Technical Documentary Report 63-89). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 423 557)

Wiener, E. L. (1962). *Knowledge of results in a monitoring task* (AMRL Technical Documentary Report 62-82). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 290 059)

Wiener, E. L. (1962). Motion prediction as a function of target speed and duration of presentation. *Journal of Applied Psychology, 46*, 420-424.

Wienke, R. E. (1964). *Absolute judgments of light intensity* (AMRL Technical Report 64-103). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 609 050)

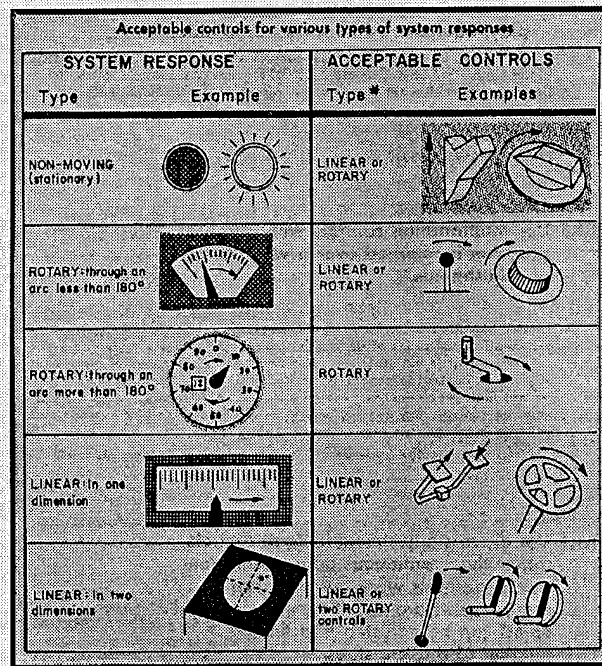
Wienke, R. E. (1964). The effect of flash distribution and illumination level upon the detection of low intensity light stimuli. *The Journal of the Human Factors Society, 6*(1).

Williams, A. C., Jr., Adelson, M., & Ritchie, M. L. (1956). *A program of human engineering research on the design of aircraft instrument displays and controls* (WADC Technical Report 56-526). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 110 424)

Williams, A. C., Jr., & Hopkins, C. O. (1958). *Aspects of pilot decision making* (WADC Technical Report 58-522). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 209 382)

Williams, A. C., Jr., Simon, C. W., Haugen, R., & Roscoe, S. N. (1960). *Operator performance in strike reconnaissance* (WADD Technical Report 60-521). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 246 545)

Wing, J. F. (1963). *Measuring amount of prior exposure to meaningful words* (AMRL Technical Documentary Report 63-94). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 413 206)



THE DESIGN OF ACCEPTABLE CONTROLS
A figure illustrating acceptable controls for several types of system responses from research done under R&D Project Number 7180, "Applications to Equipment Design." The document gave general rules for selecting controls, discussed control characteristics, and gave considerable attention to detailed design recommendations. The work was done by Jerome H. Ely, Robert M. Thomson and Jesse Orlansky of Dunlap and Associates, Inc. WADC Technical Report 56-172 (1956)

Wing, J. F., & Touchstone, R. M. (1963). *A bibliography of the effects of temperature on human performance* (AMRL Technical Documentary Report 63-13). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 404 913)

Winner, R. N., & Zilgalvis, A. (1963). *Cathode-ray tube instrument synthesis system* (AMRL Technical Documentary Report 63-84). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 424 542)

Wolf, E., & Zigler, M. J. (1955). Course of dark adaptation under various conditions of pre-exposure and testing. *Journal of the Optical Society of America, 45*, 696-702.

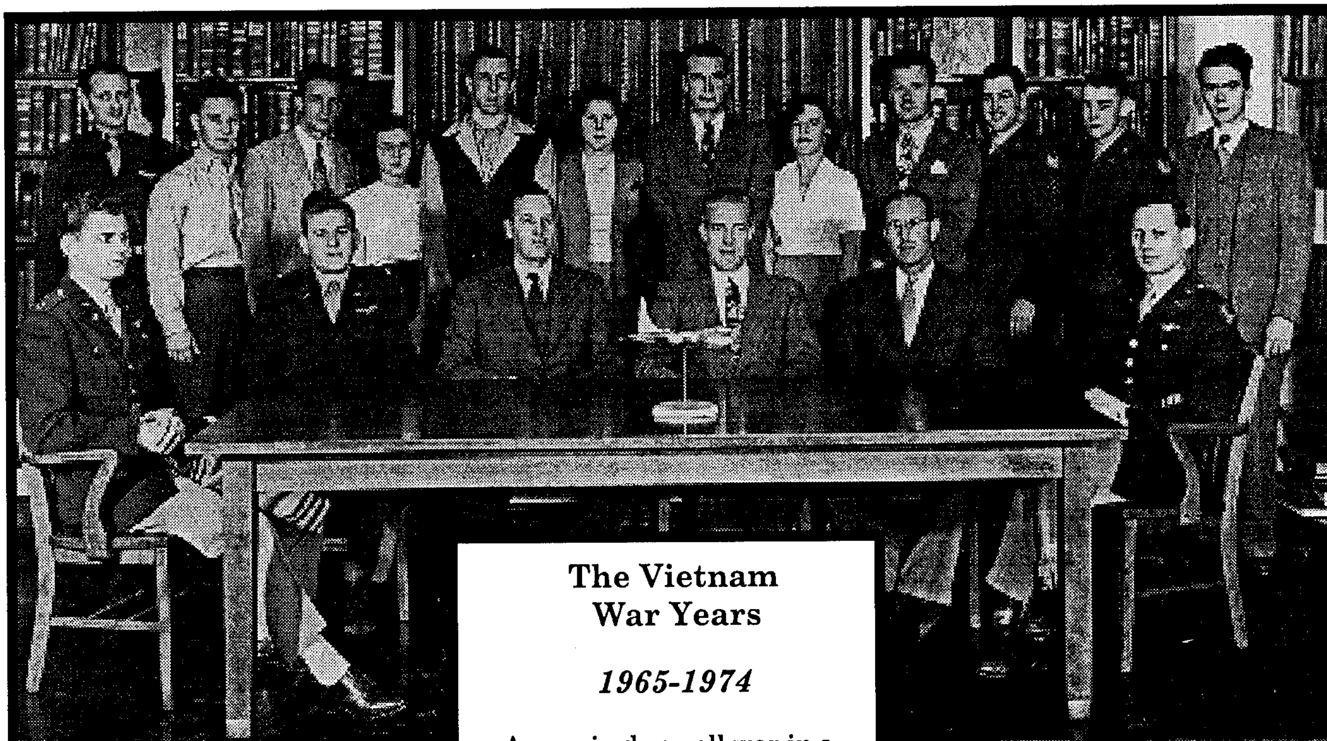
Wolf, E., & Zigler, M. J. (1959). *Some relationships of glare and target perception* (WADC TR59-394). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 231 279)

Wright, G. O. (1960). *A general procedure for systems study* (WADD Technical Note 60-18). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 236 040)

Wright, G. O., Deininger, R. L., McGuire, J. C., & Queal, R. W., Jr. (1958). *Equipment maintenance with various numbers of service men: A simple analysis* (WADC Technical Report 58-543). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 206 921)

Zeigen, R. S., Alexander, M., & Churchill, E. (1960). *A head circumference sizing system for helmet design including three-dimensional presentations of anthropometric data* (WADD Technical Report 60-631). Wright-Patterson AFB, OH: Wright Air Development Division. (DTIC No. 251 939)

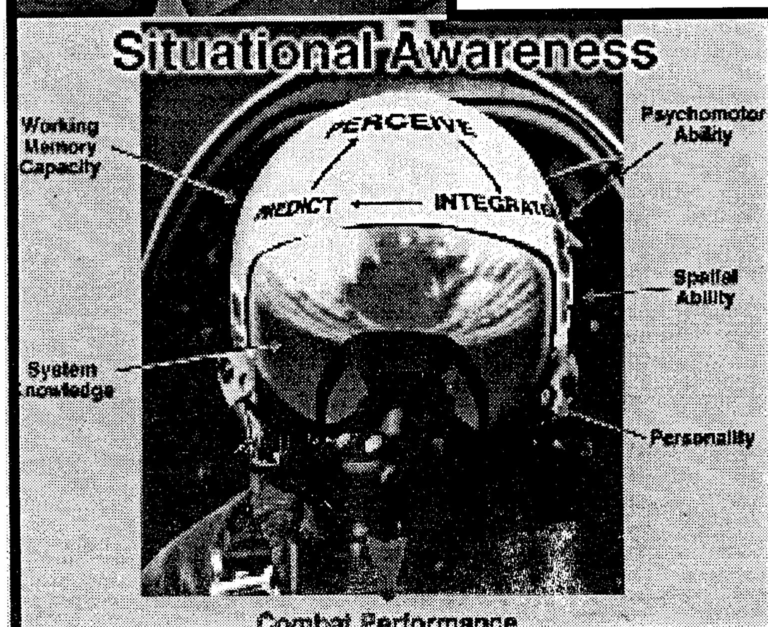
Zink, D. L., Steedman, W. C., & Baker, C. A. (1962). Distance estimates in an unstructured visual field. *American Psychologist, 17,* 386.



The Vietnam War Years

1965-1974

A seemingly small war in a far-off land will teach the nation painful lessons about fighting limited wars with limited military objectives and limited success. As in all wartime eras, pressure on the military and its laboratories to expedite better weapons to the battlefield is intense. A famous laterally firing gun-ship concept is co-founded in the Human Engineering Division and used effectively in Vietnam. The strong scientific and technical leadership of Drs. Christensen and Warrick continues.



Alexander, M., & Clauser, C. E. (1965). *The anthropometry of common working positions* (AMRL Technical Report 65-73). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 632 241)

Alexander, M., Garrett, J. W., & Flannery, M. P. (1969). *Anthropometric dimensions of Air Force pressure-suited personnel for workspace and design criteria* (AMRL Technical Report 69-6). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Alexander, M., Garrett, J. W., & Riepenhaff, R. R. (1972). *Pilot arm-reach and cockpit control locator machine* (AMRL Technical Report 73-73). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Alexander, M., Garrett, J. W., & Robinette, J. C. (1970). *Anthropological applications in high altitude flight systems* (AMRL Technical Report 70-3). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Alexander, M., & Laubach, L. L. (1968). *Anthropometric dimensions of the human ear (A photogrammetric study of USAF flight personnel)* (AMRL Technical Report 67-203). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Alexander, M., & Laubach, L. L. (1973). *The effects of personal protective equipment upon the arm-reach capability of USAF Pilots* (AMRL Technical Report 72-93). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A011 580)

Archer, R. (1970). *Rear projection display device* (AFAL Technical Report 69-343). Wright-Patterson AFB, OH: Air Force Avionics Laboratory.

Aume, N. (1972). *Human Engineering Computer Aided Design - HECAD* (AMRL-TR-72-71). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Aume, N. M. (1969). *Estimation of target locations with conventional measurement units* (AMRL Technical Report 69-21). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 700 060)

Aume, N. M. (1969). *Human ability to estimate target locations with respect to two points* (AMRL Technical Report 69-44). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 701 389)

DESIGN DATA FOR FEMALE CLOTHING
Measuring the biceps of the flexed left arm of a female Air Force member during data collection for an anthropometric survey. The data were used in the design, sizing, and procurement of clothing and the intelligent design of equipment and layout of functional workspaces for women in the military. This work was done by Charles E. Clauser and Lt Col Pearl E. Tucker of AMRL and John T. McConville, E. Churchill, Lloyd L. Laubach and J.A. Reardon of Webb Associates, Inc. AMRL-TR-70-5 (1972).

Aume, N. M. (1971). *Human estimation of proportional distances and distance ratios with the aid of a reference length* (AMRL Technical Report 70-78). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 730 283)

Aume, N. M. (1973). *The composition of reported how-malfunctioned codes* (AMRL Technical Report 72-89). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 767 200)

By the mid 1960s . . . NASA had taken over the manned space program, and the lab concentrated its efforts on weapon systems used in the Vietnam War. They developed side-firing gunships that became one of the most effective weapons of that war.

— May 1985, "Human Engineering, Yesterday and Today," Civilian Employees Reporter

Aume, N. M. (1973). An exploratory study of arm-reach dynamics under several levels of gravity. *Ergonomics, 16*(4), 481-494.

Aume, N. M. (1973). *A two-reference-point procedure for locating a target* (AMRL Technical Report 72-90). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 767 211)

Aume, N. M., & Topmiller, D. A. (1970). An evaluation of experimental how-malfunctioned codes. *Human Factors, 12*(3), 261-269.

Basinger, J. D., & Holden, L. D. (1967). *Development of measurement techniques for evaluation of a visual simulation system* (AMRL Technical Report 67-90). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 820 280)

Bate, A. J. (1968). *Cockpit warning systems comparative study* (AMRL Technical Report 68-193). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 695 462)

Bate, A. J., & Bates, C., Jr. (1967). *A comparison of cockpit warning systems* (AMRL Technical Report 66-180). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 655 772)

Bate, A. J., & Porterfield, J. L. (1966). *Effects of display width on side-looking radar target recognition* (AMRL Technical Report 66-160). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 810 795)

Bate, A. J., & Self, H. C. (1967). *Target detection on side-looking radar when image motion can be temporarily delayed* (AMRL TR 67-23). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 667 202)

Bate, A. J., & Self, H. C. (1968). *Effect of an auxiliary magnification display on side-looking radar target recognition* (AMRL Technical Report 67-134). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 673 872)

Bate, A. J., & Self, H. C. (1968). *Effects of simulated task loading on side-looking radar target recognition* (AMRL Technical Report 67-141). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 673 873)

Bates, C., Jr., Heckart, S. A., Self, H. C., McKechnie, D. F., & Hanavan, E. P. (1968). *Visual reconnaissance with two fields of view under conditions of poor visibility* (AMRL Technical Report 68-43). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 839 086)

Behling, E. A. (1971). *Long-line loiter: Personnel retrieval system* (AMRL Technical Report 69-140). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 727 007)

Behling, E. A., Pilmer, R. B., & Jumper, E. J. (1972). *Long-line loiter personnel retrieval system: Triaxial acceleration tests* (AMRL Technical Report 70-104). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 749 518)

Berkhout, J., O'Donnell, R. D., & Leverett, S. (1973). *Changes in electroencephalogram spectra during repeated exposure to +GZ acceleration* (AMRL Technical Report 72-123). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 764 815)

Birt, J. A., & Task, H. L. (Eds.). (1973). *Proceedings of a Symposium on Visually-Coupled Systems: Development and Applications* (AMD Technical Report 73-1). Brooks AFB, TX: Aerospace Medical Division. (DTIC No. 916 572)

Bradley, J. V. (1966). *Studies in research methodology: VII. The central limit effect for two dozen populations and its correlation with population moments* (AMRL Technical Report 66-242). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 653 189)

Brainard, R., & Caum, K. B. (1965). *Evaluation of an image quality enhancement technique* (AMRL Technical Report 65-143). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 624 470)

Brainard, R. W., & Ornstein, G. N. (1965). *Image quality enhancement* (AMRL Technical Report 65-28). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 616 895)

Brandt, W. E., Jr. (1970). *Program documentation for the 1827 data control unit input/output subroutines* (AMRL Technical Report 70-151). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A010 658)

Brandt, W. E., Jr. (1970). *Program documentation for the hypoxia stress real-time program* (AMRL Technical Report 70-150). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A009 560)

Brandt, W. E., Jr. (1974). *Program documentation for the all digital cockpit display system programs* (AMRL Technical Report 74-145). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A013 846)

Brandt, W. E., Jr., Wartluft, D. L., & Sebasky, G. M. (1971). *Summary of several software packages developed for human engineering systems simulation (HESS) facility* (AMRL Technical Report 71-96). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 731 581)

Briggs, G. E., Fisher, R. P., Greenberg, S. N., Lyons, J. J., Peters, G. L., & Shinar, D. (1972). *Multi-task time-sharing requirements* (AMRL Technical Report 71-105). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 755 363)

Briggs, G. E., Peters, G. L., & Fisher, R. P. (1972). On the locus of the dividend-attention. *Perception and Psychophysics, 11*(4), 315-320.

Brownell, C., Forbes, F. W., Schofield, J. N., Jr., & Zappanti, A. J. (1966). EVA associated with the assembly and service of large structures. *Proceedings of National Conference on Space Maintenance and Extra-Vehicular Activities.* Orlando, FL. (DTIC No. 641 695)

Campbell, J. M., & Gollin, E. S. (1967). An exposure control for the Kodak Carousel Model 700 Projector. *Journal of Experimental Analytical Behavior, 10,* 211-212.

Chason, L. R., Schwank, J. C. H., & Hughes, R. L. (1973). *Target vigilance effects from visual obstructions imposed by helmet-mounted display hardware* (AMRL Technical Report 73-17). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 770 297)

Chiles, W. D. (1966). Work-rest schedules under conditions of long term performance. *NASA Symposium on the Effects of Confinement on Long Duration Manned Space Flights.* Washington, DC: NASA Office of Manned Space Flight.

VILLAGE USED IN AN AIRBORNE STUDY OF THE EFFECT OF OBSERVER FIELD OF VIEW

A simulated Viet Cong village used in an airborne study of visual reconnaissance with two fields of view. This study was in support of Advanced Development Program 665A, "Reconnaissance Strike," and Task 718404, "Advanced Systems Human Engineering Design Criteria." The work was done by Charles Bates, Jr., Steve A. Heckart, Herschel C. Self, D.F. McKechnie, and E.P. Hanavan. AMRL-TR-68-43 (1968)

Chiles, W. D. (1966). *Assessment of the performance effects of the stresses of space flight* (AMRL Technical Report 66-192). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 649 881)

Chiles, W. D. (1966). Methodological problems of assessing the psychological status of the on-orbit astronaut. *Proceedings of the 23rd International Congress of Psychology Symposium No. 28: Psychological Problems of Man in Space* (pp. 99-104). Moscow.

Christensen, J. M. (1965). Performance capabilities of man on earth and in space: A study in continuity. *Advances in the Astronautical Sciences, 20.*

MEASURING ARM REACH CAPABILITY
A subject in a test apparatus for measuring the arm reach capability of lightly clothed and pressure-suited air crewmen. The data attained were used for the placement of aircraft controls. The work was done under Workunit 71840808, "Layout of Workplaces" by John W. Garrett, Milton Alexander, and Chester W. Matthews. AMRL-TR-70-33 (1970)

Christensen, J. M. (1966). Individuals and us. *Human Factors, 8*(1), 1-6.

Christensen, J. M. (1967). An overview of human factors engineering national safety congress transactions. *Industrial Safety, 12,* 37-48.

Christensen, J. M. (1969). Human factors engineering considerations in systems development. In W. T. Singleton, J. G. Fox, & D. Whitfield (Eds.), *Measurement of man at work: An appraisal of physiological and psychological criteria in man-machine systems.* London: Taylor & Francis.

Christensen, J. M. (1970). Human Engineering Division program of Armstrong Research Laboratory. *Medical Service Digest, 21*(4).

Christensen, J. M. (1974). *Human factors in engineered systems — Where the (inter) action is* (AMRL Technical Report 74-98). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. AD 785 214)

Christensen, J. M., & Kraft, C. L. (1965). Some characteristics of man pertinent to spacecraft design and operations. *Space research: Directions for the future, part three.* Woods Hole, MA: National Academy of Sciences-National Research Council.

Christensen, J. M., Miller, J. W., Farr, M. J., Beach, L. R., & Katchmar, L. T. (1967). Contributions of engineering psychology to military systems. In J. E. Uhlaner (Ed.), *Psychological research in national defense today* (Report No. TR-S-1). Arlington, VA: U.S. Army Behavioral Sciences Research Laboratory.

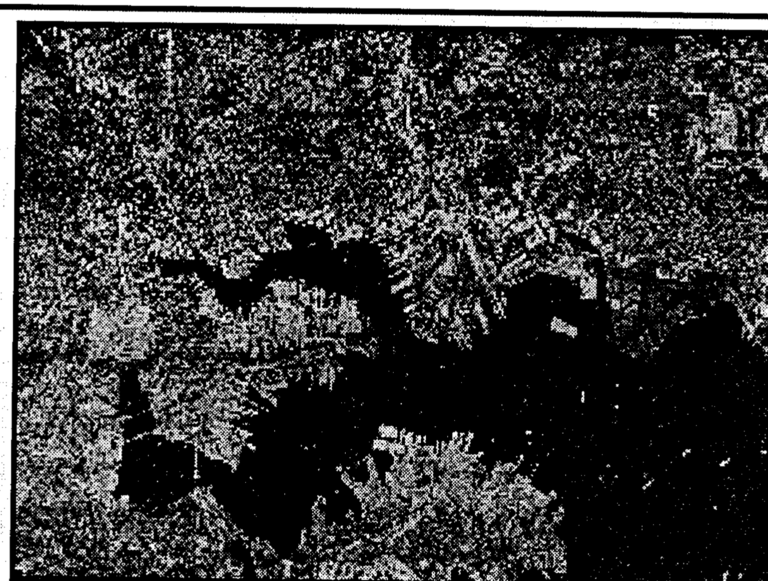
Christensen, J. M., & Mills, R. G. (1967). What does the operator do in complex systems. *Human Factors, 9*(4), 329-340.

Christensen, J. M., & Simons, J. C. (1970). Human performance in space systems. *Lectures in aerospace medicine.* Brooks AFB, TX: USAF School of Aerospace Medicine.

Chubb, G. P. (1965). *Height and width of the visible task area as a function of task and subject location* (AMRL Memorandum P-87). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

TESTING DETECTION OF BRIEFED TARGETS AS A FUNCTION OF AIRCRAFT SPEED

Example of some of the side-looking radar imagery used in a study on the effects of prior target briefing on identifying targets on a display from aircraft moving with different simulated velocities. The work was performed jointly under Program 665A, "Reconnaissance/Strike Systems," and Task 718404, "Advanced Systems Human Engineering Design Criteria" by Don F. McKechnie. AMRL-TR-66-149 (1967)



Chubb, G. P., Apter, J. P., Schrenk, L. P., Wolf, J. J., & Ryan, P. J. (1970). *The use of computers for man-machine modelling: Status and plans* (AMRL Technical Report 70-60). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 711 638)

Chubb, G. P., & Mills, R. G. (1969). Development and preparation of cost-optimized troubleshooting decision trees. *Proceedings of the IEEE Automatic Support Systems Symposium for Advanced Maintainability,* 119-129.

Churchill, E. (1966). Statistical considerations. In F. Falkner (Ed.), *Human development.* Philadelphia, PA: Saunders Co.

Clark, H. J. (1965). Recognition memory for random shapes as a function of complexity, association value and delay. *Journal of Experimental Psychology, 69,* 590-594.

Clark, H. J. (1965). Space rendezvous using visual cues only. *Human Factors, 7,* 63-70.

Clark, H. J. (1966). Control of a remote maneuvering unit during satellite inspection. *Human Factors, 8,* 573-582.

Clark, H. J. (1966). Optimum angular accelerations for control of a remote maneuvering unit. *Human Factors, 8*(3), 217-233.

Clark, H. J. (1968). Random shape recognition at brief exposure durations. *Psychonomic Science, 12*(6), 245-246.

Clark, H. J. (1968). *A survey of aircraft visual approach slope indicators* (AMRL Technical Report 68-30). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 840 114)

Clark, H. J., & Knoll, R. L. (1969). Variables underlying the recognition of random shapes. *Perception and Psychophysics, 5*(4).

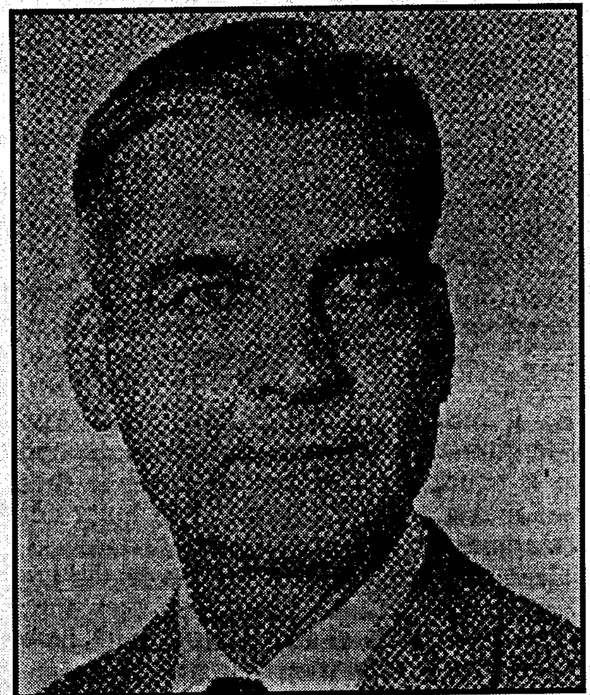
Clauser, C. E., McConville, J. T., & Young, J. W. (1969). *Weight, volume, and center of mass of segments of the human body* (AMRL Technical Report 69-70). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 710 622)

Clauser, C. E., Tucker, P. E., McConville, J. T., Churchill, E., Laubach, L. L., & Reardon, J. A. (1972). *Anthropometric survey of Air Force women* (AMRL Technical Report 70-5). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 743 113)

Connelly, M. E. (1966). *An analog photoresistive multiplier* (AMRL Technical Report 66-71). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 638 816)

Connelly, M. E., & Federoff, O. (1965). *A demonstration hybrid computer for real-time flight simulation* (AMRL Technical Report 65-97). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 618 706)

H.T.E. Hertzberg
Chief
Anthropometry Section and Branch
1961 to 1972



H. T. E. Hertzberg was assigned to the Aero Medical Laboratory in 1946 and later moved to the Human Engineering Division in 1961. He was the prime impetus for stimulating the military services to acknowledge the important need for definition of the human body size (anthropometric) variability of our military populations. His influence spanned the globe. The research facility, the Universite Rene Descartes in Paris, named its anthropometry laboratory in his honor. His anthropometric survey of 4000 flying personnel in 1950 became the "standard" for large-scale surveying, not only in the United States but internationally as well. Perhaps his greatest contribution was the anthropometric survey of NATO countries in 1960-61. This survey required incredible planning, organizing, and coordinating. Subjects were measured in three countries by a team with representatives from two services and three universities. The team, with Mr. Hertzberg in the lead, was in the field collecting data for a year.

As chief of the Anthropometry Section and then the Anthropometry Branch, he led his team in some of the most forward looking research of his time, including the first investigations of stereophotography as an anthropometric tool, the first developments of form-fitting liners for helmets, and the classic studies of dynamics and kinematics used in human body modeling. His work improved the fit, safety, and performance of all types of equipment systems including aircraft seats, oxygen masks, flight/space suits, high-altitude gloves, and automobiles. Many technological changes occurring since the Hertzberg era had their beginnings in his original research.

Cotterman, T. E., & Knoop, P. A. (1968). *Tables of limiting t values for probabilities to the nearest .001 (N = 2-16)* (AMRL Technical Report 67-161). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Coulter, R. P. (1969). Long line loiter. *Interceptor,* 10-12.

Crannell, C. W., & Morrissette, J. O. (1967). *A monitoring task: Random forms of graded discriminability* (AMRL Technical Report 67-5). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 645 761)

Crannell, C. W., Switzer, S. A., & Morrissette, J. O. (1965). Individual performance in cooperative and independent groups. *Journal of General Psychology, 73.*

Crawford, B. M. (1970). *Human engineering and maintainability applications* (AMRL 69-86). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 716 641)

Crawford, B. M., & Barnes, N. K. (1966). *The nature and capabilities of the cutaneous senses* (AMRL Technical Report 66-108). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 643 266)

Crawford, B. M., & Kama, W. N. (1965). Analog simulation applied to remote controls research. *Research and Technology Briefs, 3*(10).

Crawford, B. M., & Kama, W. N. (1965). Three-dimensional viewing with two-dimensional television. *Research and Technology Briefs, 3*(10).

Crawford, B. M., & Kama, W. N. (1966). Remote handling research and potential space applications. *Proceedings of Nat'l Conference on Space Maintenance and Extra-Vehicular Activities* (pp. 5.2.1-5.2.12). Orlando, FL. (DTIC No. 641 695)

Crawford, B. M., & Kama, W. N. (1967). Judgments of relative distance based on separate 2-D TV views. *Human Factors, 9*(5).

Davis, J. H., Hoppe, R. A., & Hornseth, J. P. (1968). Risk-taking: Task, response pattern, and grouping. *Organizational Behavior and Human Performance, 3*(2).

Davis, J. H., & Hornseth, J. P. (1967). Discussion patterns and work problems. *Sociometry, 30*(1), 91-103.

Davis, J. H., Kalb, R., & Hornseth, J. P. (1966). Stability of impression formation and implications for emergent group structure. *Sociometry, 29*(2), 104-120.

Deats, C. V., & Nielsen, G. (1966). *Construction of vacuum-formed control and display mockup panels* (AMRL Technical Report 66-175). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 648 519)

Dixon, B. C. (1966). *Zero-gravity maneuver instruments and instrumentation* (AMRL Technical Report 66-1). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 699 595)

Dixon, B. C. (1969). *Proposed automatic control system for flying zero gravity and subgravity maneuvers in the C-131 Airplane* (AMRL Technical Report 66-148). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 699 595)

"I got my start in the applications area of human engineering. It always impressed me that there were these guys out in the field using poorly-designed equipment—from a human engineering point of view. I felt our mission was to do something about this situation; I always thought we should have equipment designed so that at least its basic operation would be intuitively obvious . . . The one effort that I got great satisfaction out of — and that had the most benefit to the taxpayer and the flying Air Force—was the specifications and standards program. The problem is that, given the choice, most contractors will not spend the time and energy to design for the human operator, unless they have some incentive. Putting the specification and standard on the contract gives them incentive that gets them to do it. There was a lot of frustration and aggravation involved, but I still feel that this work was the most meaningful of all I have done while with the division."

— Steve Heckart
Applications Human Engineer
Human Engineering Division

Doty, A. B., Jr. (1966). *Generation of a function of two independent variables using a variable density photo plane* (WADC Technical Report 66-9). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 637 307)

Eliason, C. D. (1973). Pilot acceptance of Visually-Coupled Systems (VCS). In J. A. Birt, & H. L. Task (Eds.), *Proceedings of a Symposium on Visually-Coupled Systems: Development and Applications* (AMD Technical Report 73-1). Brooks AFB, TX: Aerospace Medical Division. (DTIC No. 916 572)

Elliott, T. K. (1965). *The effect of format and detail of job performance aids on performing simulated troubleshooting tasks* (AMRL Technical Report 65-154). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 629 992)

Elliott, T. K. (1966). *A comparison of three methods for presenting procedural troubleshooting information* (AMRL Technical Report 66-191). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Elliott, T. K. (1967). *Development of fully proceduralized troubleshooting routines* (AMRL Technical Report 67-152). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 664 076)

Elliott, T. K. (1967). *The effect of electronic aptitude on performance of proceduralized troubleshooting tasks* (AMRL Technical Report 67-154). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 664 889)

Elliott, T. K. (1967). *The Maintenance Task Simulator (MTS-2): A device for electronic maintenance research, Volume I: Application and operation* (AMRL Technical Report 67-140). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 664 085)

Elliott, T. K. (1967). *The Maintenance Task Simulator (MTS-2): A device for electronic maintenance research, Volume II: Maintenance data* (AMRL Technical Report 67-140). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 664 077)

Erickson, J. R., Zajowski, M. M., & Ehmann, E. D. (1966). All-or-none assumptions in concept identification: Analysis of latency data. *Journal of Experimental Psychology, 72*(5), 690-697.

Erlick, D. E. (1966). Human estimates of statistical relatedness. *Psychonomic Science, 5*(10), 365-366.

Erlick, D. E., & Jahnke, J. C. (1968). Delayed recognition and the serial organization of short-term memory. *Journal of Experimental Psychology, 77*(4), 641-647.

Erlick, D. E., & Mills, R. G. (1967). Perceptual quantification of conditional dependency. *Journal of Experimental Psychology, 73*(1), 9-14.

Fehr, E. R. (1973). *Optimized optical link for helmet-mounted display* (AMRL Technical Report 73-20). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 770 993)

Foley, M. F., & Tomashefski, J. F. (1969). Pulmonary function during zero-gravity maneuvers. *Aerospace Medicine, 40*(6).

Foley, W. L. (1966). *A study of light modulation and scanning techniques for application to simulation display generation* (AMRL Technical Report 66-9). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 637 307)

Forbes, F. W., Schofield, J., Hribar, V. F., & Jurich, L. (1965). *Expandable structure concept of crew transfer tunnel for space vehicles* (Report No. GER - 12134). Akron, OH: Goodyear Aerospace Corporation.

Fowler, R. L., Williams, W. E., Fowler, M. G., & Young, D. D. (1968). *An investigation of the relationship between operator performance and operator panel layout for continuous tasks* (AMRL Technical Report 68-170). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 692 126)

Freitag, M., & MacLeod, S. (1974). *The effect of scene rotation on target acquisition and tracking* (AMRL Technical Report 74-19). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A008 208)

Frost, G. G., & McCoy, W. K. (1965). *A "predictor" display for on-board rendezvous optimization* (AMRL Technical Report 65-81). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 627 192)

Furness, T. A., III. (1970). *The application of helmet-mounted displays to airborne reconnaissance and weapon delivery* (AMRL Technical Report 70-9). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC 700 515)

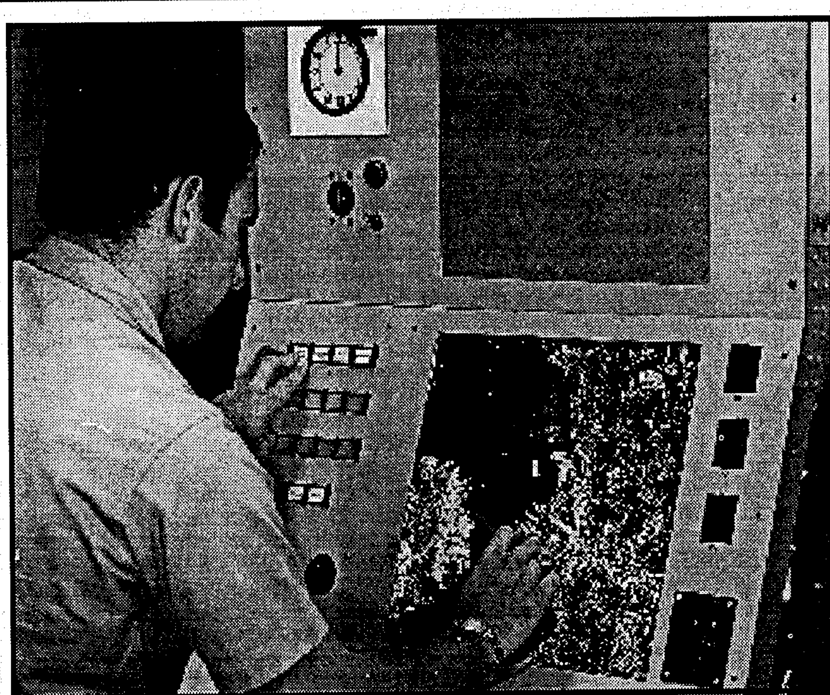
Furness, T. A., III. (1973). Overview of visually-coupled systems development program at AMRL. In J. A. Birt, & H. L. Task (Eds.), *Proceedings of a Symposium on Visually-Coupled Systems: Development and Applications* (AMD Technical Report 73-1). Brooks AFB, TX: Aerospace Medical Division. (DTIC No. 916 572)

TARGET DETECTION COMPARED WITH DIFFERENT SENSORS

Military targets in a study comparing laser line-scan images with strip photography for ease of finding tactical targets. The work was performed under Project 7184, "Human Performance in Advanced Systems," Task 718404, "Advanced Systems Human Engineering Design Criteria" in support of the Reconnaissance Division of the USAF Avionics Laboratory, by Herschel C. Self and William S. Myers. AMRL-TR-69-115 (1970)

TESTING TARGET DETECTION WITH SIDE-LOOKING RADAR

Measuring the effects of the number of allowed target choices on the target detection behavior of observers using a moving-image display from a side-looking radar sensor. The man at the console is Dean Kocian. The work was performed jointly under Advanced Development Program 665A "Reconnaissance/Strike" and Task 718404, "Human Engineering Design Criteria for Reconnaissance and Reconnaissance/Strike Systems." The research was conducted by Herschel C. Self and Almon J. Bate. AMRL-TR-69-96 (1969)



Garrett, J. W. (1968). *Clearance and performance values for the bare-handed and the pressure-gloved operator* (AMRL Technical Report 68-24). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 681 457)

Garrett, J. W. (1969). *The adult human hand: Some anthropometric and biomechanical considerations* (AMRL Technical Report 69-122). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 724 061)

Garrett, J. W. (1970). *Anthropometry of the Air Force female hand* (AMRL Technical Report 69-26). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 710 202)

Garrett, J. W. (1970). *Anthropometry of the hands of male Air Force flight personnel* (AMRL Technical Report 69-42). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 709 883)

Garrett, J. W. (1971). *An introduction to relaxed hand anthropometry* (AMRL Technical Report 67-217). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 731 183)

Garrett, J. W., & Alexander, M. (1969). Zoom bag scenario. *Interceptor, 11*, 10-11.

Garrett, J. W., Alexander, M., & Bennett, W. G. (1967). *Two-handed retention on various handle configurations* (AMRL Technical Report 67-63). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 658 441)

Garrett, J. W., Alexander, M., & Matthews, C. W. (1970). *Placement of aircraft controls* (AMRL Technical Report 70-33). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 715 975)

Garrett, J. W., & Kennedy, K. W. (1971). *A collation of anthropometry: Volume I A-H* (AMRL Technical Report 68-1(Vol-1)). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 723 629)

Garrett, J. W., & Kennedy, K. W. (1971). *A collation of anthropometry: Volume II, I-Z & Index* (AMRL Technical Report 68-1(Vol-2)). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 723 630)

Gaudiosi, J. V. (1967). *Simultaneous 8-channel cathode ray tube display system* (AMRL Technical Report 67-13). Wright-Patterson AFB, OH: Aerospace Medical Research (DTIC No. 664 552)

Gettys, C. F., & Manley, C. W. (1968). The probability of an event and estimates of posterior probability based upon its occurrence. *Psychonomic Science, 11*(2), 47-48.

A HELMET-MOUNTED DISPLAY USED IN OPTIMIZING HELMET COUPLING

One of the helmet-mounted displays used in a program to develop an optimized optical link for a helmet-coupled system. The work was done by Mr. Eric R. Fehr of the Hughes Aircraft Company. AMRL-TR 73-20 (1973)

Gibney, T. K. (1967). *Legibility of segmented versus standard numerals: A review* (AMRL Technical Report 67-116). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 661 262)

Gibney, T. K. (1968). *Legibility of segmented versus standard numerals: The influence of the observer's task* (AMRL Technical Report 68-124). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 679 528)

Gibson, J. J., Kaplan, G., Reynolds, H. N., & Wheeler, K. (1969). The change from visible to invisible: A study of optical transitions. *Perception and Psychophysics, 5*(2), 113-116.

Girod, C. V., Jr., & Pourciau, L. L. (1967). *Study and development of television projector video amplifier techniques* (AMRL Technical Report 67-61). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 660 912)

Goldbeck, R. A., Kaeding, J. H., & Feroglia, W. E. (1966). *Odor coding for malfunction detection and diagnosis* (AMRL Technical Report 66-122). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 643 239)

Goldbeck, R. A., Wright, K. A., & Fowler, R. L. (1971). *Operator performance and panel layout for discontinuous tasks* (AMRL Technical Report 70-137). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 727 791)

Goldstein, I. L., Emanuel, J. T., & Howell, W. C. (1968). Effect of percentage and specificity of feedback on choice behavior in a probabilistic information-processing task. *Journal of Applied Psychology, 52*(2), 163-168.

Goldstein, I. L., Southard, J. F., & Schum, D. A. (1967). Feedback in a complex multiman-machine system. *Journal of Applied Psychology, 51*(4), 346-351.

Graham, D. (1967). *Research on the effect of nonlinearities on tracking performance* (AMRL Technical Report 67-9). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 823 030)

Graybiel, A., & Kellogg, R. S. (1965). *Vestibular "canal sickness" precipitated in the weightless phase of parabolic flight* (Report No. NAMI-950). U.S. Navy School of Aviation Medicine.

Graybiel, A., & Kellogg, R. S. (1966). *The inversion illusion in parabolic flight: Its probable dependence on otolith function* (Report No. NAMI-974). U.S. Naval Aerospace Medical Institute.

Grether, W. F. (1965). Human performance for military and civilian operations in space. *Annals of the New York Academy of Sciences, 134.*

Grether, W. F. (1968). Engineering psychology in the United States. *American Psychologist, 23*(10), 743-751.

"The person at the lab who had probably the greatest influence on my career was my first section chief, Ed Hertzberg. He was meticulous; he constantly tried to get us to write with some clarity of thought. He did his utmost to see that the job was done right. He was very, very thorough. I admired him for that . . . Another person was Mel Warrick. He was the acting chief when I came on board. He was a great person to talk to and a fantastic editor. I always felt we were so lucky to have him."

— Charles Clauser, Anthropologist
Human Engineering Division

Grether, W. F. (1969). *Trends and new developments in aircraft instrument lighting* (AMRL Technical Report 69-144). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 729 746)

Griffin, L. L., & Self, H. C. (1966). Human factors effort. In V. L. Tipton et al. (Eds.), *Summary of Program 665A Phase I: Subsystem and data collection effort* (SEG Technical Report 66-60). Wright-Patterson AFB, OH: Systems Engineering Group.

Gum, D. R., & Knoop, P. A. (1966). *Automated input/output diagnostics for a real time simulation research system* (AMRL Technical Report 66-133). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 655 771)

Guterman, I. M., & Glass, R. D. (1968). *Digital flight simulation study for the C-141A jet transport. Volume II. Math model analysis and test results* (AMRL Technical Report 67-169(II)). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 854 800)

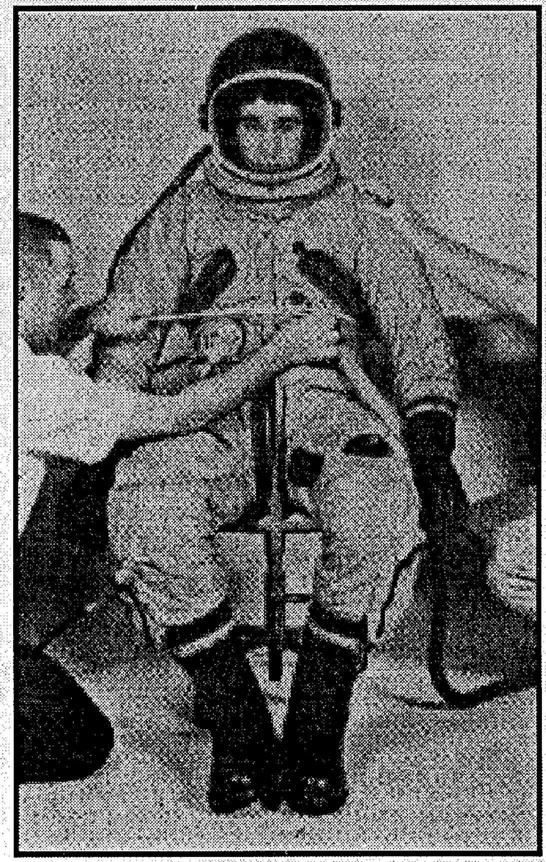
Guterman, I. M., & Wojtyna, R. J. (1968). *Digital flight simulation study for the C-141A Jet transport. Volume I. Hardware and software analysis* (AMRL Technical Report 67-169(1)). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 835 231L)

Hall, T. J., Passey, G. E., & Meighan, T. W. (1965). *Performance of vigilance and monitoring tasks as a function of workload* (AMRL Technical Report 65-22). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 615 921)

Hanavan, E. P., Jr. (1965). *A personalized mathematical model of the human body* (AIAA Paper No. 65-498). New York: American Institute of Aeronautics and Astronautics.

Hanavan, E. P., Jr., & Poli, C. R. (1965). *A three-mass retrieval study for the Gemini tethered astronaut* (SEG Technical Report 65-29). Wright-Patterson AFB, OH: Systems Engineering Group. (DTIC No. 615 979)

Hanff, G. E., Moulton, R. H., & Geller, R. E. (1965). *Personal propulsion system* (AMRL Technical Report 65-89). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 621 380)

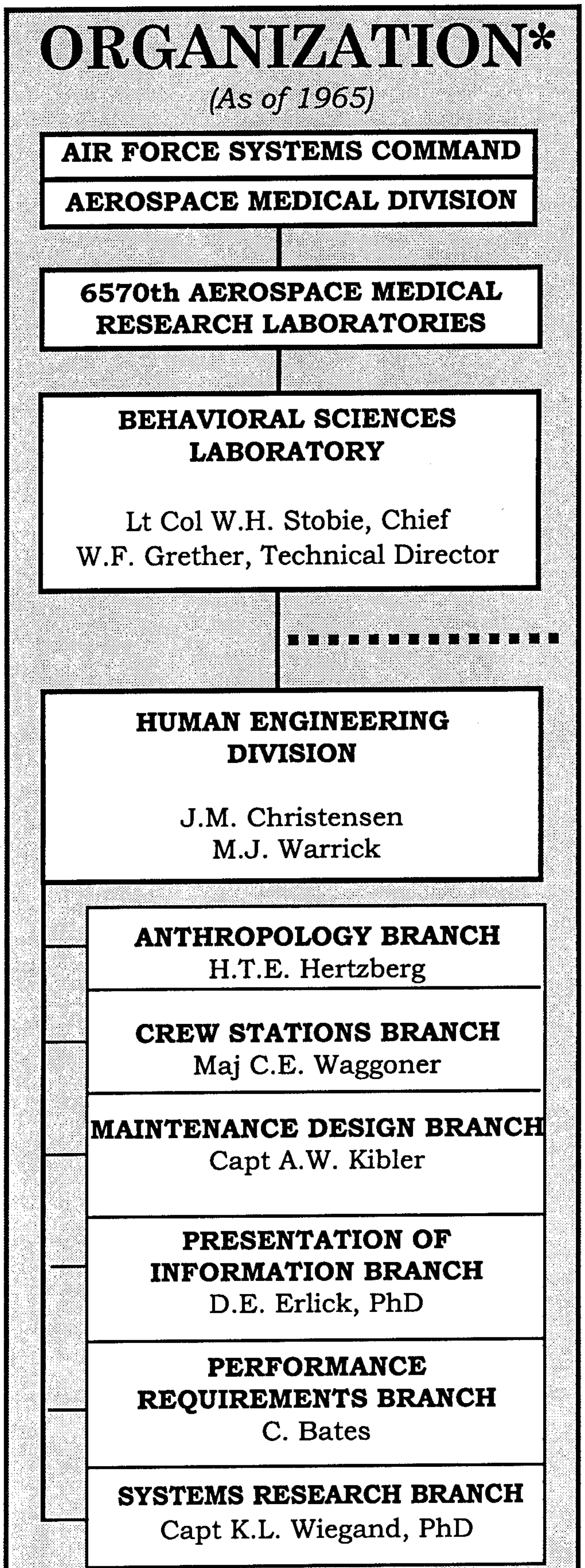


ONE OF MANY MEASUREMENTS ON PRESSURE-SUITED SUBJECTS TO OBTAIN DESIGN DATA

Milton Alexander measuring the mid-torso circumference of a seated subject wearing a pressure suit inflated to a pressure of 3.7 pounds per square inch. In this study, 138 measurements for standing, sitting, and supine positions were taken on each subject to formulate criteria for the design of workplaces. The work was done under Workunit 71840808 by Milton Alexander and John W. Garrett of the Human Engineering Division and Sgt Michael P. Flannery of the Air Defense Command. AMRL-TR-69-6 (AD 697 022)(1969)

Hannom, T. J. B., Azzari, A. J., Brooks, A. E., Hunter, J. R., Steinberg, L., & Chubb, G. P. (1967). *Development of a computer program for generating trouble-shooting decision trees* (AMRL Technical Report 67-83). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 664 603)

Harshbarger, J. H. (1965). *Development of a high resolution research television system* (AMRL Technical Report 65-235). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 630 941)



* From "Human Engineering and Training Research Divisions, March 1965," Behavioral Sciences History

Harshbarger, J. H. (1965). *Test and evaluation of electronic image generation and projection devices, Volume I. Evaluation techniques* (AMRL Technical Report 65-116(I)). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 623 908)

Harshbarger, J. H. (1966). *Color signal source for visual simulation* (AMRL Technical Report 66-116). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 645 140)

Harshbarger, J. H., & Basinger, J. D. (1965). *Test and evaluation of electronic image generation and projection devices, Volume II. Evaluation of television systems* (AMRL Technical Report 65-116(II)). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 628 693)

Harshbarger, J. H., & Basinger, J. D. (1965). *Test and evaluation of electronic image generation and projection devices, Volume III: Evaluation of projection screens* (AMRL Technical Report 65-116(III)). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 630 659)

Hart, R. S. (1974). *Effects of colored lenses on visual performance* (AMRL Technical Report 74-38). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A011 572)

Heard, J. L., Hayes, D. O., Ferrer, J. J., & Zilgalvis, A. (1969). *Design of an airborne helmet mounted display* (AMRL Technical Report 68-181). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 701 385)

Heckart, S. A., Hanavan, E. P., Porterfield, J. L., Self, H. C., & McKechnie, D. F. (1971). *Airborne visual reconnaissance with yellow sunglasses* (AFAMRL Technical Report 71-36). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. 730 290)

Heinz, D. M., Herbert, H. J., & Sharp, W. N. (1967). *Development of photoresistive elements for an analog multiplier* (AMRL Technical Report 67-168). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 671 980)

Hertzberg, H. T. E. (1966). An "anvil" for sliding caliper repair. *American Journal of Physical Anthropology, 25*(3).

Hertzberg, H. T. E. (1968). Conference on standardization of anthropometric techniques and terminology. *American Journal of Physical Anthropology, 28*(1).

Hertzberg, H. T. E. (1968). *World diversity in human body size and its meaning in American aid programs* (AMRL Technical Report 68-113). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Hertzberg, H. T. E. (1969). The anthropology of anthropomorphic dummies. *Proceedings of the 13th Stapp Car Crash Conference*, 201-214.

Hertzberg, H. T. E. (1970). *"Average" man is a fiction: Range of sizes is key to efficient work places* (AMRL Technical Report 70-58). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 727 258)

Hertzberg, H. T. E. (1972). Engineering anthropology. *Human engineering guide to equipment design (2nd ed.).* Washington, DC: U.S. Government Printing Office.

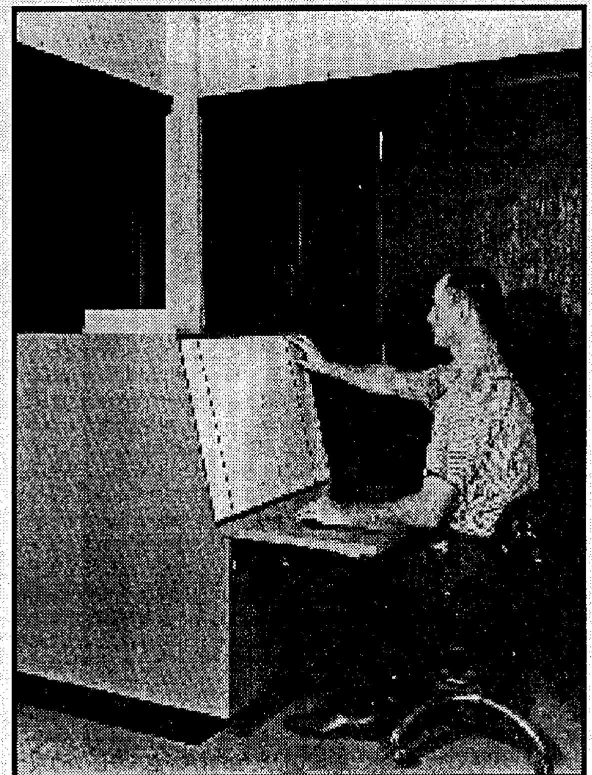
Hertzberg, H. T. E. (1972). *The human buttocks in sitting: Pressures, patterns, and palliatives* (AMRL Technical Report 71-107). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 735 316)

Hertzberg, H. T. E., & Burke, C. J. (1971). Foot forces exerted at various aircraft brake-pedal angles. *Human Factors, 13*(5), 445-456.

Hertzberg, H. T. E., & McConville, J. T. (1966). *A study of one-handed lifting* (AMRL Technical Report 66-17). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 637 764)

Hilgendorf, R. L. (1968). Arousal level and investigative response. *Psychological Reports, 23*, 715-721.

Hilgendorf, R. L. (1968). *Visual search and detection under simulated flare light* (AMRL Technical Report 68-112). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 681 129)



OBTAINING DATA FOR GROUND SUPPORT CONSOLE DESIGN

A user being tested during research intended to develop design standards for missile ground support consoles. The work was done under Project 7184, "Human Performance in Advanced Systems," Task 718404, "Human Engineering Design Criteria," and Task 718408, "Anthropometry for Design." The work was conducted by K.W. Kennedy and Charles Bates, Jr. AMRL-TR-65-163 (1965)

Hilgendorf, R. L. (1969). *Arousal level theory and aerospace medical research* (AMRL Technical Report 69-27). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Hilgendorf, R. L. (1969). Optimal colors for markers and signals. *Seventh National Flying Safety Survival and Personal Equipment Symposium Proceedings, 1.*

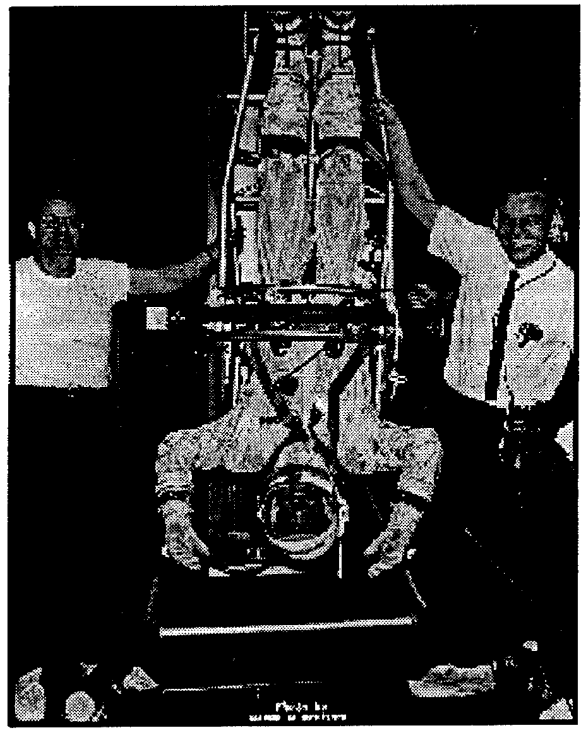
Hilgendorf, R. L. (1969). *Visual search and detection under simulated flarelight. Part II. Evaluation of a 5,000,000 candlepower (C-P) source* (AMRL Technical Report 68-112(II)). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 686 424)

Hilgendorf, R. L. (1970). An optimal hierarchy of colors for markers and signals. *Proceedings of the 8th SAFE Symposium, 1.*

"My first assignment in the Human Engineering Division (August 1967) was to Don Topmiller's Systems Effectiveness Branch. Don was trying to establish a maintainability research program; and I, having had several years of aircraft maintenance experience, was most enthused about the prospects of solving some of the problems I had encountered throughout the years. The first opportunity for research came with a request from the Aero Propulsion Laboratory at WPAFB to evaluate quick-release panel fasteners for space applications. A zero-gravity simulation facility had already been completed in Building 21 in Area B (see figures at right and below); the facility provided a gimbaled support cradle, in which a person could be securely harnessed, riding on air-bearing pads over a poured epoxy floor, while tethered to a vertical work surface. With air applied, the air bearing pads rode approximately 0.002 inches above the epoxy floor, which was level to within 0.0005 inches over a 26-by-30 foot area. Work effort was measured in terms of forces and torques applied to the work panel (measured by strain gauges) as panels having various types of hand-operated fasteners were removed and installed. The data indicated that there were significant variances across the eleven very differently designed and operated fasteners, as well as interactions between fastener design and gravity conditions. The effort was documented in the Proceedings of the Second National Conference on Space Maintenance and Extravehicular Activities, Las Vegas, Nevada, August 1968. (AMRL TR-68-117)

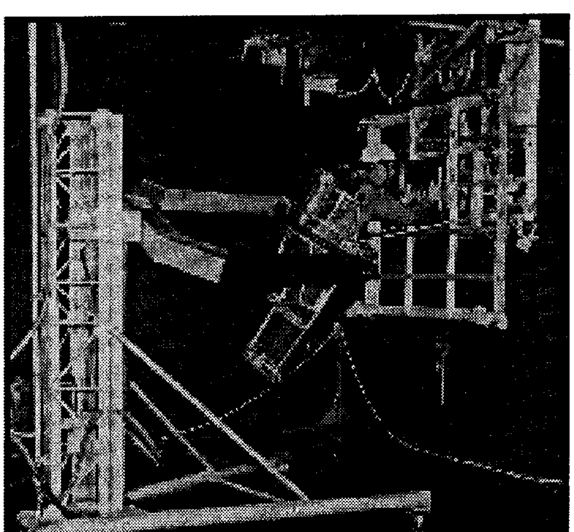
We were about to explore the effect of deflated and inflated space suit encumbrances upon performance requirements for operation of some of the better fastener designs when we were directed to stop related research in deference to NASA."

— Wayne L. Martin
Chief, Visual Display Systems Branch
Human Engineering Division



JULIEN M. CHRISTENSEN INVERTED IN ZERO-GRAVITY SIMULATION FACILITY

This device, riding on air bearing pads on a poured epoxy floor that was level to within 0.0005 inches over its 26 by 30 foot area, was used in the evaluation of forces and torques required for panel fastener operation under simulated zero-gravity conditions. Bernie DeWinter, one of several instrumentation technicians provided by the Aero Propulsion Laboratory, is on the left. Wayne L. Martin is on the right. (1968)



MEASURING FORCES AND TORQUES WHILE IN A ZERO-GRAVITY SIMULATOR

Work in conjunction with the Aero Propulsion Laboratory to determine human performance requirements for hand-operated fasteners for space applications. The support cradle, coupled with air bearings on the poured epoxy floor provided tethered movement with six degrees of freedom under near-frictionless conditions. Forces and torques required to remove and install fasteners under normal gravity and simulated zero gravity, as measured by strain gauges on the work panel, identified significant differences across fastener design and interactions between fastener design and gravity conditions. The research was done by Wayne L. Martin, Billy M. Crawford, William N. Kama and J. Herman. AMRL-TR-68-117 (1968)

Hilgendorf, R. L. (1971). Colors for markers and signals: Inflight validation. *Proceedings of the 9th SAFE Symposium*. (DTIC No. 737 901)

Hilgendorf, R. L. (1971). Current research in simulated battlefield illumination: Effects of flare shielding. *Proceedings of 2nd Annual Symposium on Psychology in the Air Force*, 282-295.

Hilgendorf, R. L. (1971). Visual performance with simulated flare light: Effects of flare-ignition altitude. *PB Human Factors, 13*(4), 379-386.

Hilgendorf, R. L. (1972). *Air-to-Ground target acquisition with flare illumination* (AMRL Technical Report 71-114). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 755 964)

Hilgendorf, R. L. (1972). *Enhancement of target/ background contrasts in search and rescue applications* (AMRL Technical Report 72-4). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Hilgendorf, R. L. (1974). Experimental evaluation of airborne illumination system. *Human Factors, 16*(2), 181-185.

Hilgendorf, R. L., MacLeod, S., & Searle, R. G. (1974). Effects of aircraft altitude and speed on air-to-ground visual target acquisition. *Aerospace Medicine, 45*(7).

Hilgendorf, R. L., & Milenski, J. (1974). *SEEKVAL Project IA1: Effects of color and brightness contrast on target acquisition* (AMRL Technical Report 74-55). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A011 547)

Hilgendorf, R. L., & Milenski, J. (1974). *SEEKVAL Project IAl: Effects of target number and clutter on static target acquisition* (AMRL Technical Report 74-14). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A011 546)

Hilgendorf, R. L., & Simons, J. C. (1970). *Flare range estimation: Evaluation of aids* (AMRL Technical Report 69-128). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 715 287)

During the 1960s . . . (members of the Human Engineering Division) were also busy making modifications for B-52 crew stations which, in turn, led to the development of new simulation techniques. Man-in-the-loop simulation put a person in a certain job scenario while he was still on the ground. This helped reduce the need for flight tests, and helped researchers measure the performance of both the person and the equipment. This system continues to be used in the Air Force. Future plans call for a similar program to be used with future strategic crew systems.

— May 1985 , "Human Engineering, Yesterday and Today," Civilian Employees Reporter

Hornseth, J. P. (1965). *Manual control of a pulse frequency modulated reaction control* (AMRL Technical Report 65-145). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 523 558)

Hornseth, J. P., & Davis, J. H. (1967). Individual and two-man team target finding performance. *Human Factors, 9*(1), 39-43.

Horton, J. A., & Bartucci, J. F. (1967). *Study and development of a simulation infinite depth of field optical pickup* (AMRL Technical Report 67-197). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 666 939)

Howell, W. C. (1967). An evaluation of subjective probability in a visual discrimination task. *Journal of Experimental Psychology, 75*(4), 479-486.

Howell, W. C. (1967). *Some principles for the design of decisions systems: Review of six years of research on a command-control system simulation* (AMRL Technical Report 67-136). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 665 469)

Howell, W. C., & Funaro, J. F. (1965). Prediction on the basis of conditional probabilities. *Journal of Experimental Psychology, 69*(1), 92-99.

Howell, W. C., & Gettys, C. F. (1968). *Some principles for design of decision systems: A review of the final phase of research on a command control system simulation* (AMRL Technical Report 68-158). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 234 011)

Hughes, R. L., Chason, L. R., & Schwank, J. C. H. (1973). *Psychological considerations in the design of helmet-mounted displays* (AMRL Technical Report 73-16). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 770 993)

Humes, J. M., & Bauerschmidt, D. K. (1968). *Low light level TV viewfinder simulation program, Phase B: The effects of television system characteristics upon operator target recognition performance* (AFAL Technical Report 68-271). Wright-Patterson AFB, OH: Air Force Avionics Laboratory.

Ireland, F. H. (1967). *Effects of surround illumination on visual performance. An annotated bibliography* (AMRL Technical Report 67-103). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 822 012)

Ireland, F. H., Kinslow, W., Levin, E., & Page, D. (1967). *Experimental study of the effects of surround brightness and size on visual performance* (AMRL Technical Report 67-102). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 666 045)

Izzo, L. L., & Cubberly, H. A. (1965). *Optical spot size study for data extraction from a transparence* (AMRL Technical Report 65-175). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 628 588)

Jerison, H. J. (1965). Human and animal vigilance. *Perceptual and Motor Skills, 21*, 580-582.

Jerison, H. J. (1966). Attention and discrimination: A behavioral analysis. *Proceedings of the 23rd International Congress of Psychology Symposium 5: Orienting Reflex, Alertness and Attention* (pp. 132-140). Moscow.

Jerison, H. J. (1966). Remarks on Colquhoun's: The effect of 'unwanted' signals on performance in a vigilance task. *Ergonomics, 9*, 413-416.

Jerison, H. J. (1967). Activation and long term performance. *Acta Psychologica, 27*, 373-389.

Jerison, H. J. (1967). Apparent motion of a vista: An illusion of perspective. *American Journal of Psychology, 80*, 448-453.

Jerison, H. J. (1967). Signal detection theory in the analysis of human vigilance. *Human Factors, 9*, 285-288.

Jerison, H. J., Pickett, R. M., & Stenson, H. H. (1965). The elicited observing rate and decision processes in vigilance. *Human Factors, 2*(7), 107-128.

Jex, H. R. (1967). Two applications of a critical instability task to secondary work load research. *IEEE Transactions on Human Factors in Electronics.*

Jex, H. R., Allen, R. W., & Magdaleno, R. E. (1971). *Display format effects on precision tracking performance describing functions, and remnant* (AMRL Technical Report 71-63). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 731 580)

VISIBILITY FROM THE COCKPIT

Binocular ground visibility from the cockpit of a level OV-10A-111 aircraft; extracted from a compilation of visibility measurements on several types of military aircraft. The work was performed under Program 665A, "Reconnaissance/ Strike Subsystems" and Tasks 718404, "Advanced Systems Human Engineering Design Criteria," and 718408, "Anthropology for Design" by Kenneth W. Kennedy and Don McKechnie. AMRL-TR-69-123 (1970)

Jumper, E. J. (1970). *Long-line loiter* (AMRL Technical Report 70-54). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 744 827)

Jumper, E. J. (1971). *Long-line loiter: Psychological warfare package* (AMRL Technical Report 71-85). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 732 891)

Jumper, E. J., & Bell, C. A. (1973). *Long-line loiter: Potential shock hazards of an airborne electrically conductive line* (AMRL Technical Report 71-109). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A011 544)

Kama, W. N. (1965). *Effect of augmented television depth cues on the terminal phase of remote driving* (AMRL Technical Report 65-6). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 615 929)

Kama, W. N. (1965). *Volumetric workspace study: Part II. Optimum workspace configuration for use of wrenches* (AMRL Technical Documentary Report 63-68(II)). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 631 476)

Kama, W. N. (1968). *Preferred arrangements for numbering the contacts of circular electrical connectors* (AMRL Technical Report 68-129). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 685 744)

Kama, W. N., Thorburn, D. E., Lyons, J. P., & Gillio, A. (1973). *Display design for electronic countermeasures application — Symbol coding and range presentation* (AMRL Technical Report 73-42). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A781 032)

Katz, S., Ase, P. K., Raisen, E., & Hilgendorf, R. L. (1970). *Visual performance with simulated flarelight in artificial clouds* (AMRL Technical Report 69-121). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 704 125)

Keenan, J. K., Parker, T. C., & Lenzycki, H. P. (1965). *Concepts and practices in the assessment of human performance in Air Force systems* (AMRL Technical Report 65-168). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 625 041)

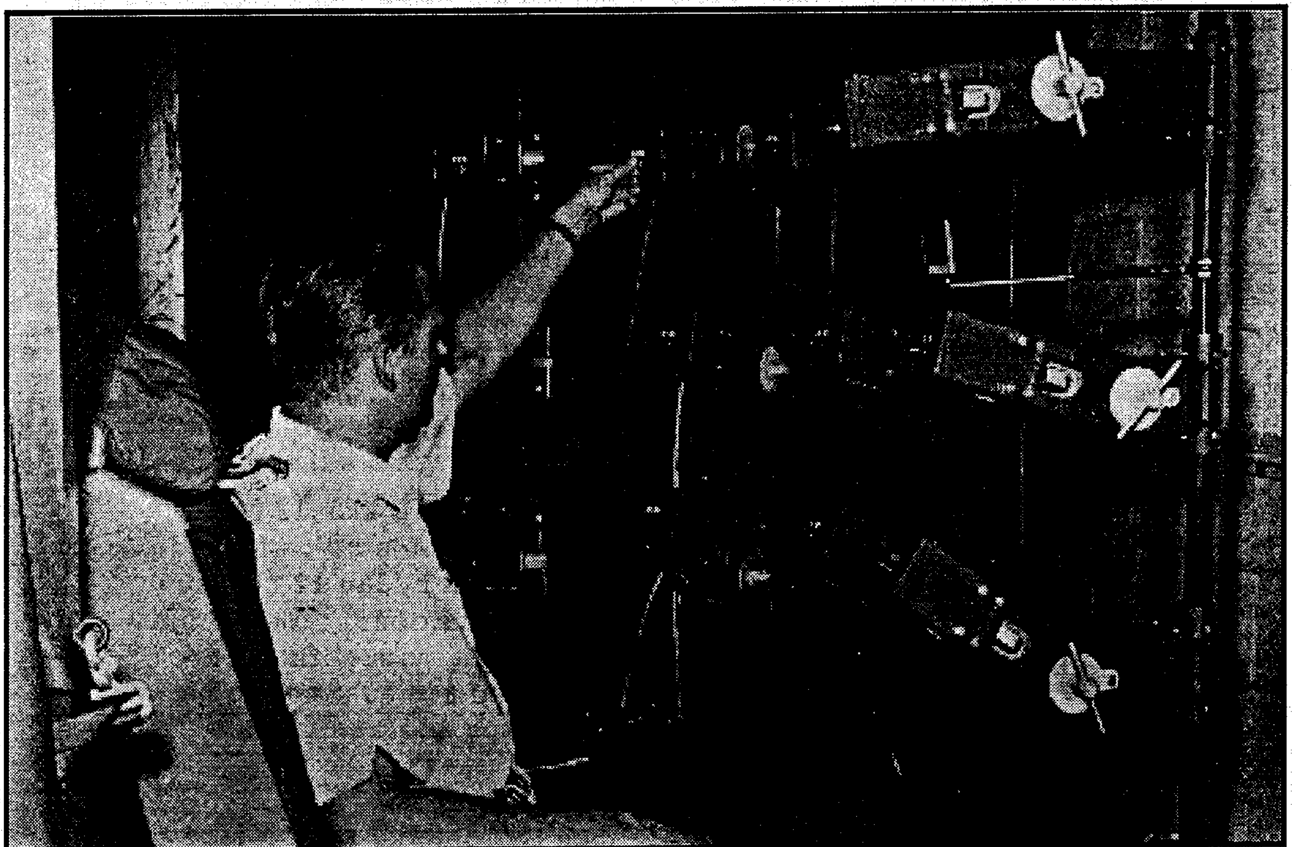
Kellogg, R. S., & Graybiel, A. (1966). *Lack of response to thermal stimulation of the semicircular canals in the weightless phase of parabolic flight* (Report No. NAMI-977). U.S. Naval Aerospace Medical Institute.

Kellogg, R. S., Miller, E. F., & Graybiel, A. (1965). Dynamic counterrolling of the eye. *Proceedings of the Role of Vestibular Organs in the Exploration of Space Symposium* (Report No. NASA ST-77). Washington, DC: National Aeronautics and Space Administration.

Kelso, B. J. (1965). Legibility study of selected scale characteristics for moving-tape instruments. *Human Factors*, 7(6), 545-554.

SETUP FOR MEASURING THE EFFECTS OF SYSTEM CHARACTERISTICS ON TARGET RECOGNITION

Terrain model and gantry-mounted, closed-circuit TV camera used to simulate aircraft flight at low-light levels. The system features a TV viewfinder for measuring the effects on target recognition of system characteristics. The work was done on contract to North American Rockwell Corporation in support of the Directorate of Reconnaissance Engineering and sponsored by the 665A Program Office. The work was done by J.M. Humes and D.K. Bauerschmidt. AFAL-TR-68-271 (1968)



TESTING THE EFFECT OF PANEL LAYOUT ON VISUAL FIXATION AND UNCERTAINTY
Testing in a workplace efficiency evaluator for the effects of panel layout on visual fixation and uncertainty. The work was conducted under Task 718402, "Criteria for the Design and Arrangement of Controls and Control Systems." The research was done by Donald A. Topmiller and Earl D. Sharp. AMRL TR-65-149 (1965)

Kennedy, K. W. (1970). *Ground areas visible from the aircraft cockpit eye position: a method of evaluation* (AMRL Technical Report 68-164). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Kennedy, K. W. (1973). *Anthropometry and kinematics in crew station design* (AMRL Technical Report 72-75). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A011 581)

Kennedy, K. W., & Bates, C. (1965). *Development of design standards for ground support consoles* (AMRL Technical Report 65-163). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 630 639)

Kennedy, K. W., & Filler, B. E. (1966). *Aperture sizes and depths of reach for one- and two-handed tasks* (AMRL Technical Report 66-27). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 646 716)

Kennedy, K. W., & Kroemer, K. H. E. (1972). *Displacements of a helmet-attached reticle under G-forces* (AMRL Technical Report 72-39). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Kennedy, K. W., & Kroemer, K. H. E. (1973). *Excursions of head, helmet and helmet-attached reticle under +G forces* (AMRL Technical Report 72-127). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 767 201)

Kennedy, K. W., & McKechnie, D. (1970). *Visibility toward the ground from selected tactical aircraft* (AMRL TR 69-123). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Kibler, A. W. (1965). The relevance of vigilance research to aerospace monitoring tasks. *Human Factors*, *7*(2), 93-99.

Kibler, A. W. (1968). *The relationship between stimulus-oriented changes in heart rate and detection efficiency in a vigilance task* (AMRL Technical Report 67-233). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 668 758)

Kincaid, J. P. (1968). Different temporal gradients of retrograde amnesia produced by metrazol or electroconvulsive shock. *Psychonomic Science, 11*(9).

Knoll, R. L., & Clark, H. J. (1969). *The physical characteristics and factor structure of a selected set of random shapes* (AMRL Technical Report 69-8). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 702 517)

Knoll, R. L., & Stenson, H. H. (1968). A computer program to generate and measure random forms. *Perception and Psychophysics, 3*(4B).

Knoop, P. A. (1966). *Programming techniques for the automatic monitoring of human performance* (AMRL Technical Report 66-16). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 637 454)

Knoop, P. A. (1967). *The application of Schur's Algorithm to the derivation of optimal numerical integration techniques for digital flight simulation* (AMRL Technical Report 67-3). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 654 320)

Kocian, D. F. (1970). Application of head-position sensing systems to remotely piloted vehicles. *Rand Symposium on Remotely Piloted Vehicles.* Santa Monica, CA: The Rand Corporation.

Kocian, D. F., & Pratt, P. (1973). Development of a helmet-mounted visor display. In J. A. Birt, & H. L. Task (Eds.), *Proceedings of a Symposium on Visually-Coupled Systems: Development and Applications* (AMD Technical Report 73-1). Brooks AFB, TX: Aerospace Medical Division. (DTIC No. 916 572)

Kraft, C. L., & Anderson, C. D. (1973). *Prediction of target acquisition performance of aerial observers and photo-interpreters with and without stereoscopic aids* (AMRL Technical Report 73-36). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 781 122)

Kroemer, K. H. E. (1967). Maximal static force vs. stress measurements as criteria for establishing optimal work conditions. *Proceedings of the 38th Annual Scientific Meeting of Aerospace Medical Association,* 166-167.

Kroemer, K. H. E. (1969). Foot operation of controls: Speed and accuracy of foot motions between targets. *Proceedings of the IEEE-GMMS ERS International Symposium on Man-Machine Systems* (Vol. 3, IEEE Conference Record No. 69-C-58-MMS). New York: Institute of Electrical and Electronics Engineers.

Kroemer, K. H. E. (1969). *Push forces exerted in sixty-five common working positions* (AMRL Technical Report 68-143). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 695 040)

Kroemer, K. H. E. (1970). *Foot operation of controls: Speed of activation and exertion of force to pedals; perception, speed and accuracy of leg and foot motions* (AMRL TR69-57). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 707 142)

Kroemer, K. H. E. (1970). Human strength: Terminology, measurement and interpretation of data. *Human Factors, 12*(3), 297-313.

"I had been a machinist before I began to get interested in human factors; so, when it came time to start rebuilding and modifying the simulators to suit our needs, I was able to go to the base machine shop and tell the machinists exactly what we needed, in their language. This way I was able to get the facility set up extremely quickly."

— Earl Sharp, Program Engineer
Human Engineering Division

"My first task was the zero-G project. I replaced Bob Kellogg, who had been developing a machine which would spin the subject around the axis of the eyes in a zero-G environment, to study whether the tendency for the eyes to counter-rotate was a vestibular function or some kind of reflex. That's how I got into the program. After that, I did a lot of work in the areas of vestibular and visual functions as well as performance—all in zero-G."

— Robert O'Donnell, Chief
Workload and Ergonomics Branch
Human Engineering Division

Kroemer, K. H. E. (1970). *Industrial Seating* (AMRL Technical Report 70-11). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 739 170)

Kroemer, K. H. E. (1971). *Seating in plant and office* (AMRL Technical Report 71-52). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 736 108)

Kroemer, K. H. E. (1972). *Human engineering the keyboard* (AMRL Technical Report 69-141). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 740 259)

Kroemer, K. H. E. (1972). *Pedal operation by the seated operator* (AMRL Technical Report 71-102). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 735 315)

Kroemer, K. H. E. (1973). *COMBIMAN: Computerized Biomechanical Man-model* (AMRL Technical Report 72-16). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 767 206)

Kroemer, K. H. E. (1974). *Designing for muscular strength of various populations* (AMRL Technical Report 72-46). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A011 537)

Kroemer, K. H. E., & Gienapp, E. M. (1970). Hand-held device to measure finger (thumb) strength. *Journal of Applied Physiology, 29*(4), 526-527.

Kroemer, K. H. E., & Howard, J. M. (1970). *Problems in assessing muscle strength* (AMRL Technical Report 68-144). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 708 741)

The Human Engineering Division includes most of the work areas of the original Psychology Branch, which ultimately grew into the Behavioral Sciences Laboratory. In this branch the primary concern is with research on human performance that could lead to improvements in the design of operating procedures for Air Force systems. The ultimate objective, of course, is to maximize the effectiveness of our weapon systems by properly matching human and machine capabilities and functions.

— March 1965, "Human Engineering and Training Research Division," Behavioral Sciences Laboratory

Kroemer, K. H. E., & Howard, J. M. (1970). Towards standardization of muscle strength testing. *Medicine and Science in Sports, 2*(4), 224-230.

Kroemer, K. H. E., & Kennedy, K. (1973). *Involuntary head movements and helmet motions during centrifuge runs with up to +6Gz* (AMRL Technical Report 72-40). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A027 612)

Kroemer, K. H. E., & Robinette, J. C. (1968). *Ergonomics in the design of office furniture: A review of European literature* (AMRL Technical Report 68-80). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 848 621)

Kroemer, K. H. E., & Robinson, D. E. (1971). *Horizontal static forces exerted by men standing in common working positions on surfaces of various tractions* (AMRL Technical Report 70-114). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 720 252)

Kulwicki, P. V. (1971). *The effects of display gain and signal bandwidth on human controller remnant* (AMRL Technical Report 70-93). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Kulwicki, P. V., Lyons, J. P., & Ravenelle, R. L. (1973). *High acceleration cockpit - the maneuvering countermeasure* (AMRL Technical Report 73-93). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 770 287)

Kulwicki, P. V., & Sinnett, J. M. (1973). *The high G approach* (AMRL Technical Report 73-27). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 757 216)

Kuperman, G. G. et al. (1973). *Reconnaissance data base* (Final Technical Report FR-73-4). Dayton, OH: Mead Technology Laboratories.

Lakshmanan, T. K., & Munt, I. (1965). *Study of electroluminescent display techniques and evaluation of a thin film cross-grid display panel* (AMRL Technical Report 65-166). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 631 465)

Laubach, L. L. (1969). Body composition in relation to muscle strength and range of joint motion. *Journal of Sports Medicine and Physical Fitness, 9*(2), 89-97.

Laubach, L. L., & Alexander, M. (1966). Measurements of muscle strength. *Integrated life support system study (20-day evaluation program)* (AMRL Technical Report 66-185, pp. 34-47). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 656 311)

Laubach, L. L., Kroemer, K. H. E., & Thordsen, L. (1972). *Relationships among isometric forces measures in aircraft control locations* (AMRL Technical Report 71-119). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 740 930)

Laubach, L. L., & Marshall, M. E. (1968). *A computer program for calculating Parnell's Anthropometric Phenotypes* (AMRL Technical Report 68-151). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 725 386)

Laubach, L. L., & McConville, J. T. (1966). Muscle strength, flexibility and body size of adult males. *Research Quarterly, 37*(3), 384-392.

Laubach, L. L., & McConville, J. T. (1966). *Relationships between flexibility, anthropometry, and the somatotype of college men* (AMRL Technical Report 65-31). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 638 282)

Laubach, L. L., & McConville, J. T. (1967). Notes on anthropometric technique: Anthropometric measurements — Right and left sides. *American Journal of Physical Anthropology, 26*(3), 367-370.

Laubach, L. L., & McConville, J. T. (1969). The relationship of strength to body size and typology. *Medicine and Science in Sports, 1*(4), 189-194.

Leuba, H. R. (1967). *Information transmission in operator report of equipment malfunction* (AMRL Technical Report 67-44). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 825 640)

Melvin J. Warrick, PhD
Associate Chief
Human Engineering Division

1958 to 1973

Mel Warrick was hired into the Psychology Branch, Aero Medical Laboratory, in March 1946 by Lt Col Paul Fitts, then its Chief. Prior to that time he had been in military service undergoing gunnery, bombardier, and radar operator/navigator training and doing research on bombardier training in the Army Air Force's Psychology Program. Before that, Mel had been trained as a private pilot, had taught high school science and mathematics, and had done research from 1941 through 1943 on bombardier selection for the US Army Adjutant General's Office and the USAF Psychology Program.

As technical advisor and associate chief, he monitored the division's exploratory development and basic research programs in the various fields of human engineering as applied to ground, air, and space equipment and systems. Under the tutelage of Dr. Fitts, Mel did his direction-of-motion stereotype (stimulus-response compatibility) studies, certain of which results have been distilled, by others, into what is now known as "Warrick's Law." Mel was the principal technical editor of the division's publications, carrying on the Fitts' tradition of clarity and parsimony in writing. He was the first of the civilian scientists to fly at "zero G" untethered and the first to provide human factors input to the Atomic Energy Commission.

He retired as a civil servant in 1975 and as a lieutenant colonel in the USAF Reserves in 1976. He has continued to this date (1995) as a "volunteer" within the Armstrong Laboratory.

Leuba, H. R., & Rhodes, K. (1968). *Information transmission in operator reports of equipment malfunction: Methodology* (AMRL Technical Report 68-20). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 838 161)

Lindemuth, R. W., & Tieber, J. A. (1965). *An analysis of the inertial properties and performance of the astronaut maneuvering system* (AMRL Technical Report 65-216). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 622 443)

Lyons, J. P., & Gillio, A. (1972). *The human engineering electronic countermeasures simulator* (AMRL Technical Report 72-59). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 781 093)

MacLeod, S. (1973). *Flare effectiveness factors: A guide to improved utilization for visual target acquisition* (AMRL Technical Report 73-46). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 773 806)

MacLeod, S., & Hilgendorf, R. L. (1973). *Air-to-Ground target acquisition with night vision devices* (AMRL Technical Report 73-87). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 769 345)

MacLeod, S., Hilgendorf, R. L., & Searle, R. G. (1974). Effects of lens color on target visibility for air-sea rescue. *Proceedings of the Human Factors Society 18th Annual Meeting,* 624-627.

Maher, F. A., & Porterfield, J. L. (1971). *Target detection and identification performance on infrared imagery collected at different altitudes* (AMRL Technical Report 70-127). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 728 243)

Martin, W. L. (1971). *Transcription errors in coded maintenance related information* (AMRL Technical Report 71-39). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 731 149)

Martin, W. L., & Chubb, G. P. (1970). *Human engineering considerations in designing interactive graphic displays for logistics management* (AMRL Technical Report 70-106). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

In 1969, Earl Sharp stumbled on to an old friend looking at some video tapes of the defensive workstation of the B-52. This fortuitous encounter led Earl to take an interest in the Electronic Warfare Officer's (EWO) workstation, which has led to a 20-year commitment to improving the design of EWO crewstations in the latest Air Force high tech bombers, including the B-52, B-1, and currently the B-2.

Earl has been the driving force behind the development of some of the most realistic bomber simulation and testing facilities in the world. Having persuaded the powers-that-be in Strategic Air Command to give him $270,000 and a B-52 training device in 1971, Earl set about putting together a high-fidelity simulation facility with the capability to collect performance data from every thrown switch, twisted knob, and CRT display. This facility has since produced valuable data which has provided the impetus for many crewstation and display design changes for the B-52, as well as being the template for a similar B-1 facility, and Earl's legacy, a B-2 test and evaluation facility.

— Klein Associates, Interview with Earl Sharp

Martin, W. L., Crawford, B. M., Kama, W. N., & Herman, J. (1968). *Quick-release fasteners for space applications* (AMRL Technical Report 68-117). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 728 518)

May, C. B., Schofield, J. N., Jr., & Vorst, L. A. (1966). AF-Gemini space maintenance experiment and simulation. *Proceedings of National Conference on Space Maintenance and Extra-Vehicular Activities.* Orlando, FL. (DTIC No. 641 695)

McCloskey, J. W., Mohlman, H., & Kellogg, R. S. (1968). *A mathematical model for the dynamic counterrolling of the human eye* (AMRL Technical Report 68-106). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 687 160)

McConville, J. T., Churchill, E., Laubach, L. L., & Alexander, M. (1972). *Anthropometry of respirator design* (HEW Report No. HSM099-71-11).

McCoy, W. K., & Frost, G. G. (1965). *Investigation of "predictor" displays in orbital rendezvous: Program summary* (AMRL Technical Report 65-138). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 624 467)

McCoy, W. K., Jr., & Frost, G. G. (1966). *Predictor display techniques for on-board trajectory optimization of rendezvous maneuvers* (AMRL Technical Report 66-60). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 635 918)

McCoy, W. K., Jr., & Frost, G. G. (1967). *A predictor display for orbital rendezvous* (AMRL Technical Report 67-7). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 645 760)

McKechnie, D. F. (1966). *An investigation of sectional aeronautical charts and series 200 charts as briefing aids for a side-looking radar reconnaissance task* (AMRL Technical Report 66-153). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 648 074)

McKechnie, D. F. (1967). *Effect of briefing and velocity on the identification of targets from side-looking radar imagery* (AMRL Technical Report 66-149). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 662 612)

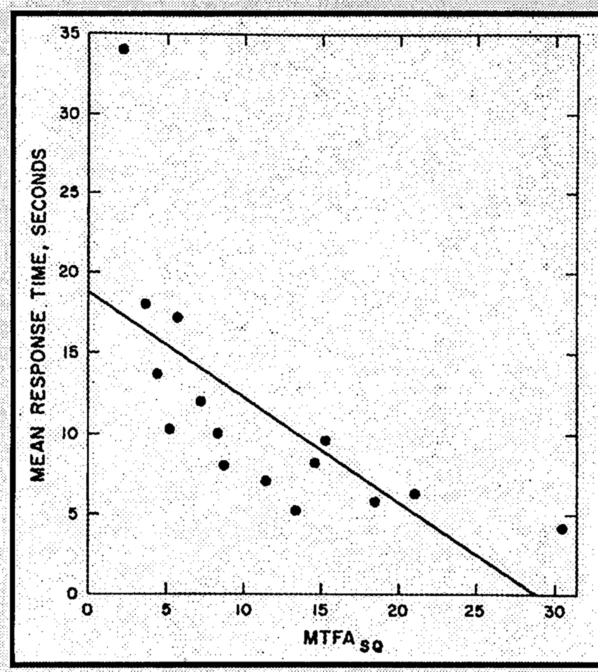


IMAGE QUALITY AND RECOGNITION TIME

Mean recognition time for human faces in a study of the effect of image quality on visual search. The work was done on a contract with the Virginia Polytechnic Institute and State University by Dr. Harry L. Snyder, Ms. Robin Keesee, Mr. William S. Beamon, and Mr. James R. Aschenbach. AMRL-TR-73-114 (1974)

McKechnie, D. F. (1970). *Comparison of a moving map display and two graphics with hand-held maps* (AMRL Technical Report 69-110). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 714 061)

McKechnie, D. F., & Griffin, L. L. (1966). Experimental use of several briefing methods as aids to target detection with high resolution reconnaissance data. *Proceedings of Symposium on Aeronautical Charts and Map Displays.*

McNeal, R. N. (1967). *Development of an input/output technique for integrated circuit simulation computers* (AMRL Technical Report 67-64). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 696 220)

Meister, D., & Farr, D. E. (1966). *Designer's guide for effective development of aerospace ground equipment control panels* (AMRL Technical Report 66-29). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 646 443)

Meister, D., & Farr, D. E. (1966). *Methodology of control panel design* (AMRL Technical Report 66-28). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 646 442)

Meister, D., & Mills, R. (1971). *Development of a human performance reliability data system* (AMRL Technical Report 71-74). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 730 910)

Meister, D., & Mills, R. G. (1971). *Development of a human performance reliability data system: Phase I* (AMRL Technical Report 71-87). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 738 322)

Merchant, J., Morrissette, R., & Porterfield, J. L. (1973). Honeywell remote oculometer. In J. A. Birt, & H. L. Task (Eds.), *Proceedings of a Symposium on Visually-Coupled Systems: Development and Applications* (AMD Technical Report 73-1). Brooks AFB, TX: Aerospace Medical Division. (DTIC No. 916 572)

Meyer, A. (1970). *AN/AAS-18 infrared set modification to dual spectrum capability* (AFAL Technical Report 70-154). Wright-Patterson AFB, OH: Air Force Avionics Laboratory.

Middleton, R. H., Alexander, M., & Gillespie, K. W. (1970). *Cockpit compatibility studies conducted with aircrew members wearing high altitude flying outfits in B-57D, B-57F, F-104B, and F-106B Aircraft* (ASD Technical Report 70-25). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 880 672)

Miller, E. F., Graybiel, A., & Kellogg, R. S. (1965). *Otolith organ activity within earth standard, one-half standard, and zero-gravity environments* (Report No. NSAM-943). U.S. Navy School of Aviation Medicine.

Miller, E. F., Kellogg, R. S., & Graybiel, A. (1965). Otolith organ activity as a function of gravitational forces from zero to earth standard. *Proceedings of the Role of Vestibular Organs in the Exploration of Space Symposium* (Report No. NASA ST-77). Washington, DC: National Aeronautics and Space Administration.

Mills, R. G. (1967). Probability processing and diagnostic search: 20 alternatives, 500 trials. *Psychonomic Science, 24*(6), 289-292.

TESTING THE EFFECTS OF PANEL LAYOUT
Testing operator performance in a study of the effects of panel layout on performance in discontinuous tasks. The work was done on contract to the Philco-Ford Corporation under Task 718404 "Human Engineering for Real-Time Reconnaissance and Weapon Delivery" by R.A. Goldbeck, K.A. Wright and R.L. Fowler. AMRL-TR-70-137 (1971)

Mills, R. G. (1968). *A structure of man-machine diagnostic information systems: Implications for human engineering research and design* (AMRL Technical Report 68-134). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 689 766)

Mills, R. G. (1968). *Use of contingent status information in diagnostic performance and related aspects for information design* (AMRL Technical Report 68-135). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 691 806)

Mills, R. G. (1970). A relative frequency principle in processing contingent information. *Psychonomic Science, 18*(4), 215-217.

Mills, R. G., & Bauer, M. A. (1969). WEIBD-WEIBG: Two programs for generating stimulus events with specified moments. *Behavioral Science.*

Mills, R. G., & Bauer, M. A. (1971). *Aircraft track initiation and maintenance in a single-operator simulated surveillance system: Technical report I* (AMRL Technical Report 70-103). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 730 609)

Mills, R. G., & Bauer, M. A. (1971). *Aircraft track initiation and maintenance in a single-operator simulated surveillance system: Technical Report II* (AMRL Technical Report 71-76). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 741 902)

Mills, R. G., & Bauer, M. A. (1974). *Aircraft track initiation and maintenance in a single-operator simulated surveillance system: Technical report III* (AMRL Technical Report 73-70). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A011 557)

Mills, R. G., Bauer, M. A., & Lum, M. D. (1969). RLIM-RSAMP: Two programs for generating correlated stimulus samples. *Behavioral Science.*

Mills, R. G., & Hatfield, S. A. (1974). Sequential task performance task module relationships, reliabilities, and times. *Human Factors, 16*(2), 117-128.

Moran, M. J. (1969). Reduced-gravity human factors research with aircraft. *Human Factors, 11*(5), 463-471.

Morrissette, J. O. (1966). Group performance as a function of task difficulty and size and structure of group: II. *Journal of Personality and Social Psychology, 3*(3), 357-359.

Morrissette, J. O., & Jahnke, J. C. (1967). No relations and relations of strength zero in the theory of structural balance. *Human Relations, 20*(2), 189-195.

Morrissette, J. O., Jahnke, J. C., & Baker, K. (1966). Structural balance: A test of the completeness hypothesis. *Behavioral Science, 11*(2), 121-125.

Morrissette, J. O., Jahnke, J. C., Baker, K., & Rohrman, N. (1967). Degree of structural balance and group effectiveness. *Organizational Behavior and Human Performance, 2,* 383-393.

Morrissette, J. O., Pearson, W. H., & Switzer, S. A. (1965). A mathematically defined task for the study of group performance. *Human Relations, 18,* 187-192.

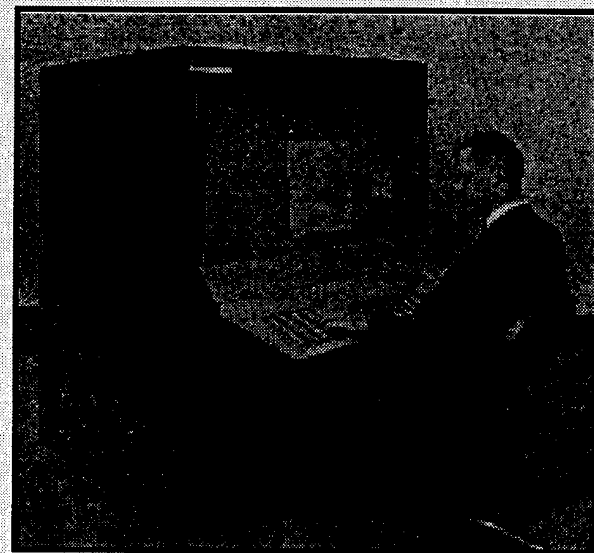
Morrissette, J. O., Switzer, S. A., & Crannell, C. W. (1965). Group performance as a function of size, structure, and task difficulty. *Journal of Personality and Social Psychology, 2*(3), 451-455.

Morrissette, J. O., & Vannoy, J. (1966). *Revision of a mathematically defined task to study group performance* (AMRL Technical Report 66-68). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 638 927)

Neuberger, T. P., Myles, W. E., & Ludwig, U. W. (1966). *Virtual image display for space flight simulator* (AMRL Technical Report 66-58). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 636 270)

Nigro, B. J. (1967). *Study of numerical integration techniques for real-time digital flight simulation* (AMRL Technical Report 67-4). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 654 307)

Nigro, B. J., Woodward, R. A., & Brucks, C. R. (1968). *A Digital computer program for deriving optimum numerical integration techniques for real-time flight simulation* (AMRL Technical Report 68-4). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 673 372)



OBTAINING DATA FOR DESIGNING INFORMATION RETRIEVAL CONSOLES

A subject using an information retrieval console in a study of control panel design methodology. The work was done on contract by the Bunker-Ramo Corporation under Task 718404, " Advanced Systems Human Engineering Design Criteria." The work was performed by David Meister and D.E. Farr. AMRL-TR-66-28 (1966)

O'Donnell, R. D., Bollinger, R., & Hartman, B. O. (1974). *The effects of extended missions on the performance of airborne command and control teams: A field survey* (AMRL Technical Report 74-20). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A011 549)

Ohlbaum, M. K., Nielsen, A. G., & McMillan, G. R. (1974). *The effect of retinal lesions on tracking performance* (AMRL-TR-74-132). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Oshima, M., & Alexander, M. (1965). *Anthropometry of Japanese Pilot* (AMRL Technical Report 65-74). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 462 062)

Passey, G. E., Alluisi, E. A., & Chiles, W. D. (1966). *Use of the experimental method for evaluation of performance in multi-man systems* (AMRL Technical Report 66-121). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 638 183)

Pearson, W. H. (1966). Estimation of a correlation coefficient from an uncertainty measure. *Psychometrika, 31*(3), 421-433.

Pearson, W. H. (1966). *Factor analysis of how-mal codes* (AMRL Technical Report 66-154). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 649 569)

Pearson, W. H. (1967). *Reliability of selected how-mal code clusters: B-58 System* (AMRL Technical Report 67-196). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 664 071)

Pearson, W. H. (1969). *Multidimensional scaling of selected how-malfunction code clusters* (AMRL Technical Report 69-15). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Pearson, W. H. (1972). *Time simulation of an air surveillance task with varying amounts of radar information* (AMRL Technical Report 72-24). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A074 866)

Pickett, R. M. (1968). *Perceiving visual texture: A literature survey* (AMRL Technical Report 68-12). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 670 225)

Pickett, R. M. (1972). *Applications of texture perception in the analysis of complex optical imagery* (AMRL Technical Report 71-81). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 746 658)

Pieper, W. J., & Folley, J. D., Jr. (1967). *Effect of ambiguous test results on troubleshooting performance* (AMRL Technical Report 67-160). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 664 891)

Porterfield, J. L., & Bate, A. J. (1969). *Target detection and recognition on single versus dual-sensor displays of infrared and side-looking radar* (AMRL Technical Report 68-127). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 690 603)

Porterfield, J. L., Heckart, S. A., Self, H. C., Hanavan, E. P., & McKechnie, D. F. (1971). *Visual reconnaissance from the nose versus side scanner stations of an aircraft* (AMRL Technical Report 71-21). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 729 226)

Porterfield, J. L., Self, H. C., Heckart, S. A., Hanavan, E. P., & McKechnie, D. F. (1971). *Airborne visual reconnaissance as a function of illumination level* (AMRL Technical Report 71-9). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 728 629)

Pritsker, A. A. B., Wortman, D. B., Seum, C. S., Chubb, G. P., & Seifert, D. J. (1974). *SAINT: Volume I. Systems analysis of integrated network of tasks* (AMRL Technical Report 73-126). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A014 843)

OBSERVER STATION USED IN TESTING THE EFFECT OF ILLUMINATION LEVEL ON TARGET DETECTION

Observer in the nose bubble of a WB-50D aircraft in an airborne study done in Panama on the effect of illumination level on visual target detection. This work, in support of Advanced Development Project 665A, was completed under Task 718404, "Human Engineering for Real-Time Reconnaissance and Weapon Delivery." The work was done by Dr. James L. Porterfield, Dr. Herschel C. Self, Mr. Steve A. Heckart, Maj E.P. Hanavan, and Mr. Don F. McKechnie. AMRL-TR-71-9 (1971)

Quinlan, R. V., & Holmquist, J. A. (1965). *Unique scan closed-loop television system* (AMRL Technical Report 65-215). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 630 905)

Retterer, B., Griswold, G. H., & Topmiller, D. A. (1965). *The validation of a maintainability prediction technique for an airborne electronic system* (AMRL Technical Report 65-42). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 622 804)

Reynolds, H. N. (1968). Temporal estimation in the perception of occluded motion. *Perceptual and Motor Skills, 26,* 407-416.

Reynolds, H. N. (1969). Visual perception beyond the atmosphere. *Aerospace Medicine, 40*(6).

Reynolds, H. N. (1971). The visual effects of exposure to electroluminescent instrument lighting. *Human Factors, 13*(1), 29-40.

Reynolds, H. N., & Grether, W. F. (1968). The effects of color of instrument lighting on absolute and acuity thresholds with exposure to a simulated instrument panel. *Aerospace Medicine, 39*(12), 1304-1309.

Rudov, M. H. (1966). Dimensionality in human information storage. *Journal of Experimental Psychology, 71*(2), 273-281.

Ruhsam, W. M., & Kiowski, J. W. (1968). *Digital and hybrid simulation of an orbital and reentry vehicle* (AMRL Technical Report 67-139). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 673 517)

Sasaki, E. H. (1965). *Feasibility of using handrails to move along a surface in weightlessness* (AMRL Technical Documentary Report 65-152). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 628 596)

Schrenk, L. P. (1965). Objective difficulty and input history as factors in sequential decision making. *Human Factors, 6,* 49-55.

Schum, D. A. (1966). Concerning the evaluation and aggregation of probabilistic evidence by man-machine systems. *Proceedings of the 3rd Congress on Information Sciences and Technology,* 337-347.

MEASURING FEMALE HANDS FOR DESIGN
Milton Alexander measuring wrist breadth in research on the anthropometry of the Air Force female hand. The work was done in support of Project 7184, "Human Performance in Advanced Systems" by John W. Garrett. AMRL-TR-69-26 (1970)

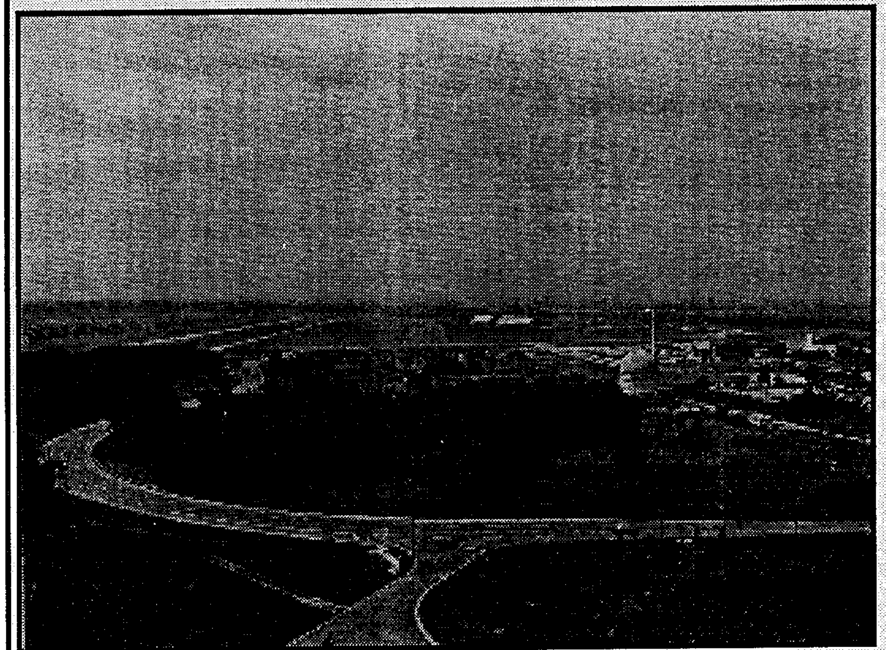
Schum, D. A. (1966). Inferences on the basis of conditionally nonindependent data. *Journal of Experimental Psychology, 72*(3), 401-409.

Schum, D. A. (1966). Prior uncertainty and amount of diagnostic evidence as variables in a probabilistic inference task. *Organizational Behavior and Human Performance, 1*(1), 31-54.

Schum, D. A. (1969). *Concerning the simulation of diagnostic systems which process complex probabilistic evidence sets* (AMRL Technical Report 69-10). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 691 238)

Schum, D. A., Goldstein, I. L., Howell, W. C., & Southard, J. F. (1967). Subjective probability revisions under several cost-payoff arrangements. *Organizational Behavior and Human Performance, 2,* 84-104.

Schum, D. A., Goldstein, I. L., & Southard, J. F. (1965). *Further investigation of the effects of reduced input data fidelity upon the determination of posterior probabilities in a simulated threat-diagnosis system* (AMRL Technical Report 65-233). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 631 781)



TARGET RANGE USED IN A STUDY OF COLORED SUNGLASSES

Above is the target range at Wright-Patterson Air Force Base used in a study of the effects of colored sunglasses on visual performance. The study was done on a contract to Multi-Tech Associates under Project 7184, "Human Performance in Advanced Systems." The work was conducted by Robert S. Hart. AMRL-TR-74-38 (1974)

Schum, D. A., Goldstein, I. L., & Southard, J. F. (1965). *The influence of experience and input information fidelity upon posterior probabilities estimation in a simulated threat diagnosis system* (AMRL Technical Report 62-25). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 615 758)

Schum, D. A., Goldstein, I. L., & Southard, J. F. (1966). Research on a simulated Bayesian information-processing system. *IEEE Transactions on Human Factors in Electronics, HFE-7*(1), 37-48.

Schum, D. A., Southard, J. F., & Wombolt, L. F. (1969). *Aided human processing of inconclusive evidence in diagnostic systems: A summary of experimental evaluations* (AMRL Technical Report 69-11). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 691 239)

Sears, C. W., & Dixon, B. C. (1971). *Long-line-loiter support equipment* (AMRL Technical Report 70-142). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 884 090)

Seeman, J. S., Smith, F. H., & Mueller, D. D. (1966). *A technique to investigate space maintenance tasks* (AMRL Technical Report 66-32). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 639 059)

Seidenstein, S., & Berbert, A. G., Jr. (1966). *Manual control of remote manipulators: Experiments using analog simulation* (AMRL Technical Report 66-21). Wright-Patter-son AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 638 500)

Seifert, D. J., & Chubb, G. P. (1973). *Computer models of man-machine survivability/vulnerability* (AMRL Technical Report 72-69). Wright-Patterson AFB, OH: Aerospace Medical Research Lab-oratory. (DTIC No. 762 528)

Self, H. C. (1968). *Research findings on target detection that have implications for pattern recognition* (AMRL Technical Report 68-156). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 691 092)

Self, H. C. (1968). *Target search from the air: Some research results and their implications for COIN warfare systems* (AMRL Technical Report 68-131). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Self, H. C. (1971). Acquisition slant ranges for targets. *Proceedings of the Air Force Systems Command/Rand Symposium on Remotely Piloted Vehicles: Volume 1, Technology Base*, 190-211.

Self, H. C. (1971). *Acquisition slant ranges for targets* (AMRL Technical Report 70-96). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 727 772)

Self, H. C. (1971). Image evaluation for the prediction of the performance of a human observer. In H. Leibowitz (Ed.), *"Image Evaluations," Proceedings of the 1969 NATO Symposium on Image Evaluation*, 130-142.

Self, H. C. (1972). The construction and optics problems of helmet-mounted displays. In J. A. Birt, & H. L. Task (Eds.), *Proceedings of a Symposium on Visually-Coupled Systems: Development and Applications* (AMD Technical Report 73-1, pp. 174-194). Brooks AFB, TX: Aerospace Medical Division. (DTIC No. 916 572)

Self, H. C. (1972). Performance measures, observer selection, and reconnaissance/strike systems effectiveness. In D. B. Jones (Ed.), *A collection of unclassified technical papers on target acquisition, Volume 1* (pp. 23-35). Orlando, FL: Naval Training Center. (DTIC No. 758 022)

Self, H. C. (1972). *Very low altitude detection of small stationary targets at very slow speeds: A simulation study using strip photography* (AMRL Technical Report 72-7). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 754 928)

Self, H. C., & Bate, A. J. (1969). *The effect of number of allowed target choices upon the target-reporting behavior of radar observers* (AMRL Technical Report 69-96). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 701 382)

Self, H. C., & Heckart, S. A. (1973). *TV target acquisition at various frame rates* (AMRL Technical Report 73-111). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A006 893)

Self, H. C., & Myers, W. S. (1970). *A preliminary comparison of lasers with photography for finding tactical targets* (AMRL Technical Report 69-115). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 705 652)

Senter, R. J. (1965). *Review of mnemonics and mnemonotechnics for improved memory* (AMRL Technical Report 65-180). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 629 594)

Sharp, E. D. (1967). *Effects of primary task performance on response time to toggle switches in a workspace configuration* (AMRL Technical Report 66-190). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 655 770)

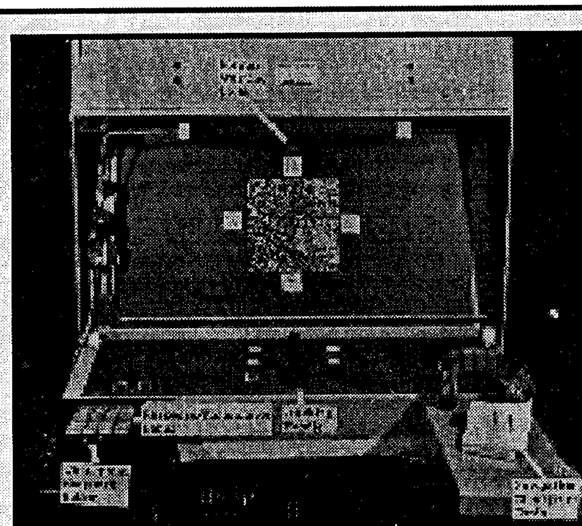
Sharp, E. D. (1969). *Human factors considerations to the design, placement and function of vehicle controls* (AMRL Technical Report 69-28). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Sharp, E. D., Hall, M. G., Talcott, D., & Kama, W. N. (1972). *Human Engineering report: B-52 EW officers crew station phase VI ECM configuration.* Tinker AFB, OK: Oklahoma City Air Material Center.

Sharp, E. D., Hall, M. G., Talcott, D., & Kama, W. N. (1974). *Analysis of operator performance using the Phase VI Electronic Warfare Crew Station.* Offutt AFB, NE: Strategic Air Command.

Sharp, E. D., & Hornseth, J. P. (1965). *The effects of control location upon performance time for knob, toggle switch and push button* (AMRL Technical Report 65-41). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 626 610)

Sharp, E. D., & Sasaki, E. H. (1967). *Effect of distance between an indicator and its corresponding control upon activation time* (AMRL Technical Report 67-6). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 645 753)



SIMULATED NAVIGATION TASK USED IN A STUDY OF WARNING SYSTEMS

The display of moving, rear-projected strip photography and the associated equipment used in a simulated aircraft navigation task in comparing the merits of malfunction warning systems. This study by Almon J. Bate under Task 718404, "Advanced Systems Human Engineering Design Criteria" supplemented an earlier 1966 study on warning systems. AMRL-TR-68-193 (1968)

Shim, I. H., Cubberly, H. A., Volpe, G. T. et al. (1967). *System design study for radar land mass transparency preparation* (AMRL Technical Report 67-56). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 664 357)

Shim, I. H., Wigby, J. I., & Mletzko, A. E. (1968). *Design study for radar land mass simulation system* (AMRL Technical Report 68-8). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 673 908)

Shoenberger, R. W., & Harris, C. S. (1965). *Human performance as a function of changes in acoustic noise levels* (AMRL Technical Report 65-165). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 628 198)

Siegel, A. I., & Lanterman, R. S. (1968). *A portable test battery for comparatively evaluating operator performance in full-pressure suit assemblies* (AMRL Technical Report 68-74). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 680 825)

Siegel, A. I., Wolf, J. J., Fischl, M. A., Miehle, W., & Chubb, G. P. (1971). *Modification of the Siegel-Wolf Operator Simulation Model for on-line experimentation* (AMRL Technical Report 71-60). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 737 798)

Simons, J. C. (1967). *Low-altitude recce/strike techniques, problems* (ASD Technical Report 67-17). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 824 279)

Simons, J. C., & Dixon, B. C. (1969). *Long-line loiter: Improvement of some free-fall and circling-line techniques* (ASD Technical Report 69-95(1)). Wright-Patterson AFB, OH: Aeronautical Systems Division. (DTIC No. 732 226)

Simons, J. C., Walk, D. E., & Sears, C. W. (1965). *Mobility of pressure-suited subjects under weightless and lunar gravity conditions* (AMRL Technical Report 65-65). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 626 979)

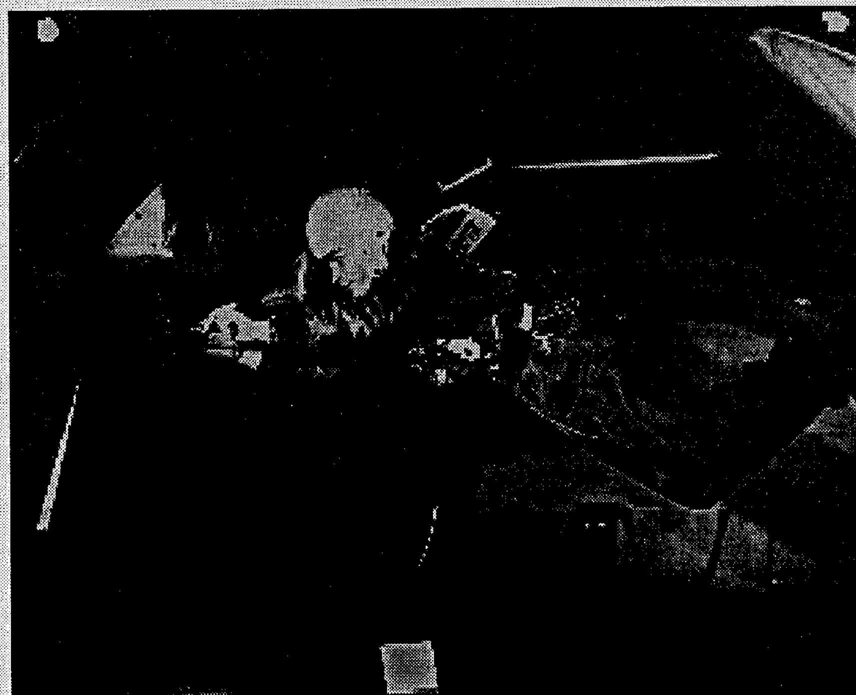
Simons, J. C., Walk, D. E., & Sears, C. W. (1965). Motion performance of pressure-suited subjects under zero and lunar gravity conditions. *Aerospace Medicine, 36*(5).

Smith, E. A., Williams, G. S., & Mohlman, H. T. (1965). *Goniophotometer to measure diffusion characteristics of rear projection screens* (AMRL Technical Report 65-207). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 631 315)

Smith, R. L., Blanchard, R. E., & Westland, R. A. (1970). *Acquisition of restore time data by subjective techniques* (AMRL Technical Report 70-76). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 727 015)

TESTING COCKPIT WARNING SYSTEMS ON A SUBJECT BUSILY DETECTING TARGETS

Almon J. Bate testing an observer engaged in a target detection task. The study uses a moving rear-projection display image of strip photography on an information-retrieval console. The study, which compared cockpit warning systems, was done under Task 718404, "Advanced Systems Human Engineering Design Criteria" by Almon J. Bate and Charles Bates, Jr. AMRL-TR-66-180 (1967)



TOOL USE IN ZERO GRAVITY
An experimental subject floating in an aircraft flying a special flight path that produces a zero gravity condition. The study examines the effect on tool use of zero gravity. Here the subject is using a screwdriver to make instrument adjustments.

Smith, R. L., & Westland, R. A. (1970). *The status of maintainability models: A critical review* (AMRL Technical Report 70-97). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 727 014)

Smith, R. L., Westland, R. A., & Crawford, B. M. (1970). The status of maintainability models: A critical review. *Human Factors, 12*(3).

Snyder, H. L. et al. (1967). *Low light level TV viewfinder simulation program, Phase A, Part II, Vol. I: Simulation plans* (AFAL Technical Report 67-293). Wright-Patterson AFB, OH: Air Force Avionics Laboratory. (DTIC No. 825 950)

Snyder, H. L. et al. (1967). *Low light level TV viewfinder simulation program, Phase A, Part II, Vol. II: Simulation plans* (AFAL Technical Report 67-293). Wright-Patterson AFB, OH: Air Force Avionics Laboratory. (DTIC No. 825 850)

Snyder, H. L. (1974). Image quality and face recognition on a television display. *Human Factors, 16*(3), 300-307.

Snyder, H. L., Keesee, R., Beamon, W. S., & Aschenbach, J. R. (1974). *Visual search and image quality* (AMRL Technical Report 73-114). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Snyder, R. G., Chaffin, D. B., & Schutz, R. K. (1972). *Link system of the human torso* (AMRL Technical Report 71-88). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 754 924)

Sorensen, R. A. (1974). *The effect of flare drift on target acquisition performance* (AMRL Technical Report 74-73). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A006 756)

Soxman, E. J. (1967). *Development of thin film electroluminescent display techniques* (AMRL Technical Report 67-1). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 655 903)

Steedman, W. C. (1967). Absolute judgments of size in a restricted visual environment. *Perceptual and Motor Skills, 24*, 731-736.

Stenson, H. H. (1966). *Human factors in the design of electroluminescent displays for aerospace vehicles* (AMRL Technical Report 66-130). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 646 459)

Stenson, H. H. (1966). The physical factor structure of random forms and their judged complexity. *Perception and Psychophysics, 1*, 303-310.

Stenson, H. H. (1968). The psychophysical dimensions of similarity among random shapes. *Perception and Psychophysics, 3*(3B), 201-214.

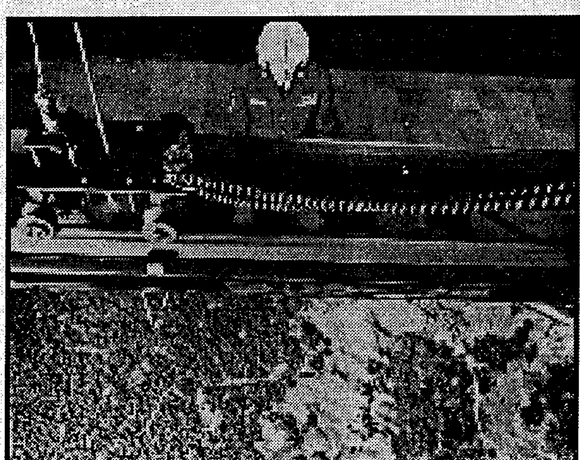
Stephens, M. W., & Michels, K. M. (1965). *Motivational correlates of individual differences in performance* (AMRL Technical Report 65-39). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 618 895)

Stoner, L. D., Horton, J. A., & Carson, E. R. (1966). *Simulation image generation: Study of television camera and optical pickup from scale relief models* (AMRL Technical Report 66-18 (I)). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 485 304L)

Stouffer, J. R. (1968). *Ultrasonic determination of body composition* (AMRL Technical Report 68-61). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 695 470)

Strub, M. H. (1969). Experience and prior probability in a complex decision task. *Journal of Applied Psychology, 53*(2), 112-117.

Task, H. L., & Hornseth, J. P. (1974). *An evaluation of the Honeywell 7A Helmet-Mounted Display in comparison with a panel display: Target detection performance* (AMRL Technical Report 74-3). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 775 993)



TESTING FLARE EFFECTIVENESS WITH A TERRAIN BOARD SIMULATION

An observer, using a terrain board simulation, looking for ground targets in a study that examines the effectiveness of air-dropped flares. The work was part of a joint services program on air-to-ground target acquisition, with the findings to go into the "Joint Munitions Effectiveness Manual." The work was performed by Dr. Sheldon MacLeod AMRL-TR-73-46 (1973)

Thackray, R. I. (1965). Correlates of reaction time to startle. *Human Factors, 7*, 74-80.

Thorburn, D. E. (1971). *Centrifuge validation of a tactile "G-limit" warning device* (AMRL Technical Report 71-80). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 732 194)

Thorburn, D. E. (1971). *Voice warning systems - a cockpit improvement that should not be overlooked* (AMRL Technical Report 70-138). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 882 758)

Thorburn, D. E., & Ravenelle, R. L. (1973). *Tactile Information Presentation (TIP)* (AMRL Technical Report 72-106). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 761 796)

Thorburn, D. E., Sharp, E. D., Kama, W. N., & Lyons, J. P. (1971). *Display design for electronic countermeasures applications - scope size and threat density* (AMRL Technical Report 71-69). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 731 186)

Thordsen, L., Kroemer, K. H. E., & Laubach, L. L. (1972). *Human force exertions in aircraft control locations* (AMRL Technical Report 71-119). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 740 930)

Topmiller, D. A. (1965). *Application of behavioral science to performance aid development* (AMRL Technical Report 65-146). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 623 619)

Topmiller, D. A. (1965). A factor analytic approach to maintainability prediction. *Proceedings of ESD Symposium on Systems Effectiveness* (ESD Technical Report 65-413). Hanscom AFB, MA: Electronic Systems Division.

Topmiller, D. A. (1966). Human factors and systems effectiveness. *Annals of Reliability and Maintainability, 5*.

Topmiller, D. A. (1966). Man-machine command-control-communication simulation studies in the Air Force. In C. P. Tsokos, & R. M. Thrall (Eds.), *Decision information.* New York: Academic Press.

Topmiller, D. A. (1968). *Mathematical models of human performance in man-machine systems* (AMRL Technical Report 68-22). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 673 348)

Topmiller, D. A. (1971). Human engineering systems simulation: Historical development and management considerations. In A. I. Siegel (Ed.), *Proceedings of Symposium on Computer Simulation as Related to Manpower and Personnel Planning.* Naval Personnel Research & Development Laboratory.

Topmiller, D. A., & Sharp, E. D. (1965). *Effects of visual fixation and uncertainty on control panel layout* (AMRL Technical Report 65-149). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 627 702)

Vannoy, J., & Morrissette, J. O. (1969). *Group structure, effectiveness, and individual morale* (AMRL Technical Report 66-207). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC 705 963)

Verdi, A. P., Ornstein, G. N., Heydorn, R. P., & Frost, G. G. (1965). *Effects of display quickening on human transfer functions during a dual-axis compensatory tracking task* (AMRL Technical Report 65-174). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 627 671)

Walk, D. E., & Sasaki, E. H. (1965). *Procedure to assess energy expended during a short period task* (AMRL Technical Report 65-205). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 637 692)

Warrick, M. J., Kibler, A. W., & Topmiller, D. A. (1965). Response time to unexpected stimuli. *Human Factors, 7,* 81-86.

HELMET-MOUNTED DISPLAY TECHNOLOGY
Thomas Furness of the Human Engineering Division checking out an early helmet display fabricated by industry for the division. Furness, Charles Bates, Jr., and Dean Kocian began pushing the development of the technology of helmet-mounted sights, helmet-mounted displays, and visually-coupled systems in the early 1960s with funds for industrial development and laboratory investigations obtained from several sources, including the Air Force, the US Army, and NASA. Their input of ideas, enthusiasm, and funds greatly hastened the development of the technology, bringing helmet-mounted equipment into operational use by the armed forces years earlier than would have happened without their efforts. This, and related work, is continuing with the leadership of Dean Kocian, Harry Lee Task, Brian Tsou, and other laboratory personnel.

Wartluft, D. L. (1970). *Program documentation for the HESS accounting system Daily Post-processor Program* (AMRL Technical Report 70-148). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A009 533)

Wartluft, D. L. (1970). *Program documentation for the HESS accounting system Monthly Analysis Program (MONTHACT)* (AMRL Technical Report 70-147). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A009 532)

Wartluft, D. L. (1970). *Program documentation for the stick-man program* (AMRL Technical Report 70-149). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A009 559)

Wartluft, D. L. (1974). *Program documentation for the RPV simulation program* (AMRL Technical Report 74-146). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A019 753)

Wasicko, R. J., & Magdaleno, R. E. (1965). *Effects of nonlinearities on human operator tracking performance: A review of the literature* (AMRL Technical Report 65-158). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 626 036)

Watkins, W. H., & Clark, H. J. (1968). Forced-choice technique: Inter-alternative comparisons. *Psychonomic Science, 11*(10), 351-352.

Weisz, A. Z., Goddard, C., & Allen, R. W. (1965). *Human performance under random and sinusoidal vibration* (AMRL Technical Report 65-209). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 631 457)

White, R. M., Dainoff, M. J., & Reynolds, R. E. (1972). *Factors affecting the detection and recognition of colored targets* (AMRL Technical Report 72-38). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 746 297)

Wienke, R. E., & Steedman, W. C. (1965). Apparent motion in geometric depth. *Human Factors, 7*(3), 215-218.

Williams, W. L. (1969). *Predictor displays for low-altitude high-speed flight* (AMRL Technical Report 68-118). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 857 276)

Wing, J. F. (1965). *A review of the effects of high ambient temperature on mental performance* (AMRL Technical Report 65-102). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 624 144)

"The lab in the sixties was not only smaller, but dramatically different. There was practically no research money. The money we did have went mostly into an OSU (Ohio State University) system research contract. The other big contract was with University of Dayton to provide experimental subjects. Most of the researchers did their own research with limited in-house funds; very little contractor research was being done at that time."

— Steve Heckart
Applications Human Engineer
Human Engineering Division

Wing, J. F. (1965). Upper thermal tolerance limits for unimpaired mental performance. *Aerospace Medicine, 36*, 960-964.

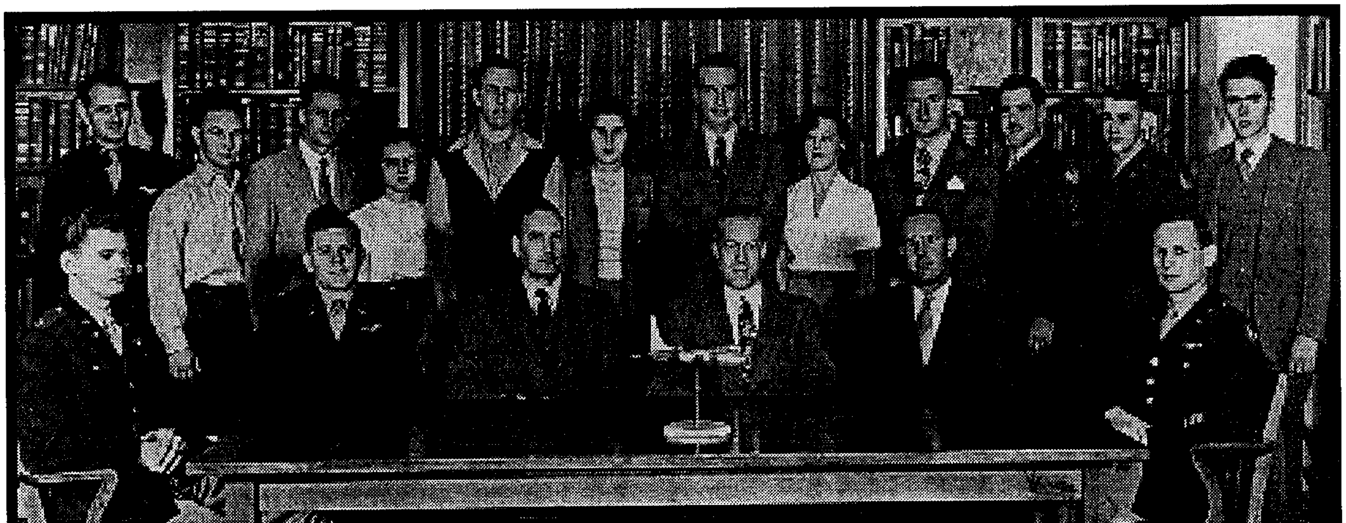
Wing, J. F., & Touchstone, R. M. (1965). *The effects of high ambient temperature on short-term memory* (AMRL Technical Report 65-103). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 623 683)

Wortman, D. B., Pritsker, A. A. B., Seum, C. S., Seifert, D. J., & Chubb, G. P. (1974). *SAINT: Volume II. User's manual* (AMRL Technical Report 73-128). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A011 582)

Zamarin, D. M., Gabriel, R. F., & Rickerd, L. D. (1973). *Investigation of flare patterns as means of overcoming spatial disorientation occurring under night strike conditions* (AMRL Technical Report 73-95). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 770 309)

Zink, D. L. (1965). Visual experiences of the astronauts and cosmonauts. In C. A. Baker (Ed.), *Visual capabilities in the space environment.* New York: Pergamon Press.

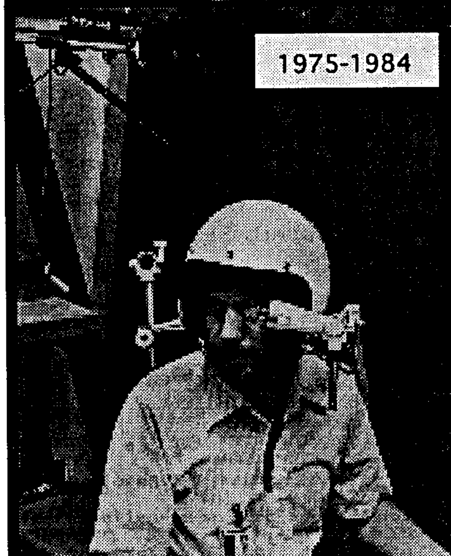
Zink, D. L. (1967). Psychological research on Bayes' Theorem as a model for human information processing. *Proceedings of the Third Missile and Space Division Seminar on Bayes' Theorem and Its Application to Reliability Measurement* (Document No. 6750213). Philadelphia, PA: General Electric Co.

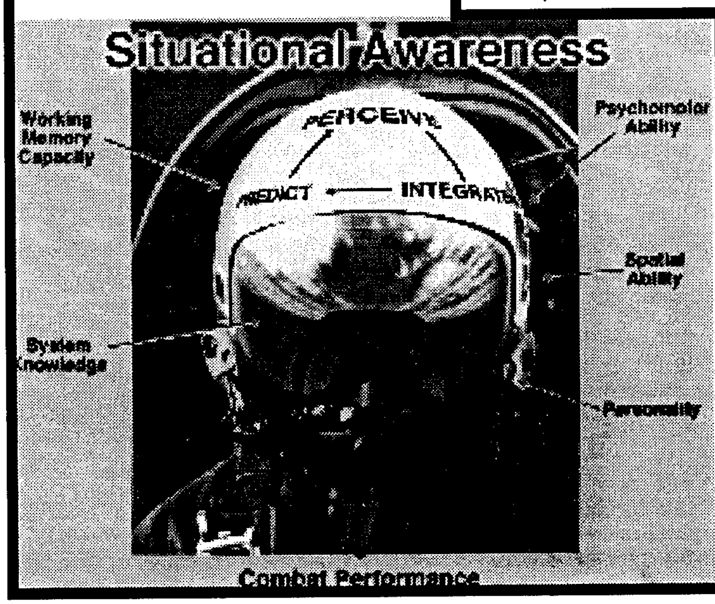


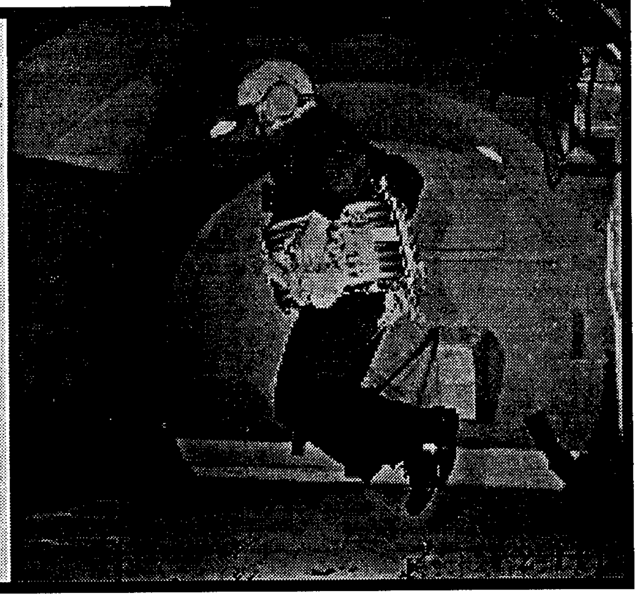
Keeping Pace with the Avionics Revolution

1975-1984

Computer technology enters a period of phenomenal growth triggering a revolution in aircraft avionics. Efforts to bring additional information into the cockpit and extend Air Force mission areas will bring about the development of controls and displays of unprecedented complexity. Resulting human engineering issues of pilot workload and man-machine interface must be addressed. The stage is set for revolutionary strides in such areas as visually-coupled systems, mental workload, and anthropometry. Dr. Julian Christensen retires from the Human Engineering Division and is replaced by Mr. Charles Bates, Jr.







Alexander, M., Heckart, S. A., McConville, J. T., & Mitchell, S. M. (1978). Human factors engineering evaluation of the munitions transfer truck. In V. L. Mahugh (Ed.), *Development test and evaluation of Munitions Transfer Truck A/S 32K-5* (ADTC Technical Report 78-2, pp. 61-75). Eglin AFB, FL: Armament Development and Test Center.

Alexander, M., Laubach, L. L., & McConville, J. T. (1976). *Effects of encumbering clothing, personal-protective equipment and restraints on body size and arm-reach capability of USAF Aircrewmen* (AMRL Technical Report 76-118). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A036 682)

Alexander, M., & McConville, J. T. (1979). *Anthropometric sizing, fit-testing and evaluation of the MBU-12/P oral-nasal oxygen mask* (AMRL Technical Report 79-44). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A074 732)

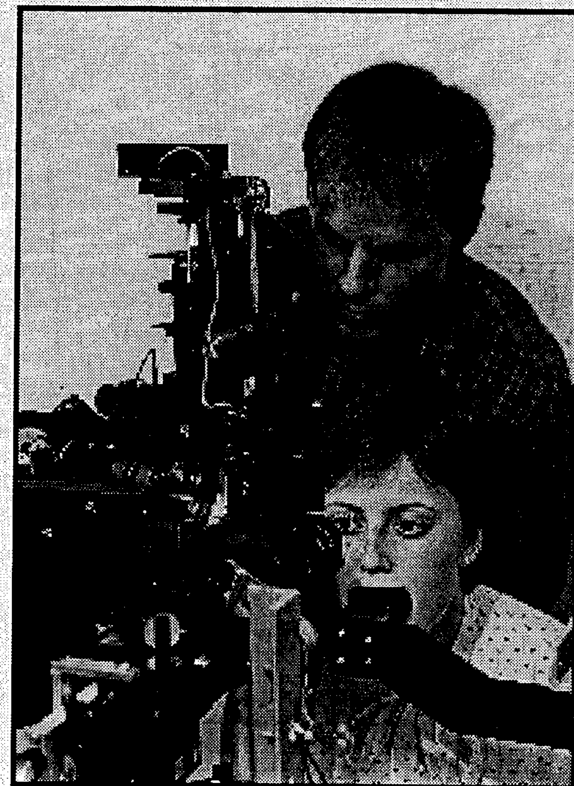
Alexander, M., McConville, J. T., & Tebbetts, I. (1979). *Revised height/weight sizing programs for men's protective flight garments* (AMRL Technical Report 79-28). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A070 732)

Almagor, M., Farley, W. W., & Snyder, H. L. (1979). *Spatio-temporal integration in the visual system* (AMRL Technical Report 78-126). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A069 558)

Anderson, C. D., & Kraft, C. L. (1977). *Stereo acuity and reconnaissance. Phase I: Development of a precision chromostereopsis test and test equipment* (AMRL Technical Report 76-112). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A040 450)

Aume, N. M. (1984). *A machine for weight-lift testing* (AFAMRL Technical Report 84-040). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A101 766)

Aume, N. M., McDaniel, J. W., & Garver, T. (1983). *Human strength capabilities for the operation of parachute ripcords and riser releases* (AFAMRL Technical Report 83-081). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A138 328)



EYE TRACKING RESEARCH
Kirk Moffitt and Martha Hausman working with the Stanford Research Institute (SRI) eye tracker as part of research on eye tracking at the Human Engineering Division in 1979-1980.

Aume, N. M., & Mills, R. G. (1981). *The results of AFAMRL Remotely Piloted Vehicle (RPV) simulation studies VII and VIII* (AFAMRL Technical Report 80-98). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A100 551)

Aume, N. M., Mills, R. G., & Gillio, A. A. (1976). *Summary report of AMRL Remotely Piloted Vehicle (RPV) system simulation study IV results* (AMRL Technical Report 76-55). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A028 877)

Aume, N. M., Mills, R. G., Gillio, A. A., Sebasky, G., & Wartluft, D. (1977). *Summary Report of AMRL Remotely Piloted Vehicle (RPV) system simulation study V results* (AMRL Technical Report 77-23). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A041 673)

Ayoub, M. M., Deivanayagam, S., & Kennedy, K. W. (1976). *Paths of movement for selected body segments during typical pilot tasks* (AMRL Technical Report 75-111). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A025 773)

Ayoub, M. M., Deivanayagam, S., & Kennedy, K. W. (1977). *Selected design parameters for reclining seats based on engineering anthropometry* (AMRL Technical Report 77-44). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A048 458)

Ayoub, M. M., Dryden, R. D., McDaniel, J. W., Knipfer, R. E., & Aghazadeh, F. (1978). Modeling of lifting capacity as a function of operator and task variables. In C. G. Drury (Ed.), *Safety in Manual Materials Handling* (DHEW(NIOSH) Publication No. 78-185, pp. 120-130).

Ayoub, M. M., Powers, R. F., Bethea, N. J., Lambert, B. K., Martz, H. F., & Bakken, G. M. (1978). *Establishing criteria for assigning personnel to Air Force jobs requiring heavy work* (AMRL Technical Report 77-94). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A060 114)

Bapu, P., Evans, S., Kikta, P., Korna, M., & McDaniel, J. (1981). *User's guide for COMBIMAN programs (Computerized Biomechanical Man-Model), Version 4* (AFAMRL Technical Report 80-91). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A097 705)

Bapu, P., Evans, S., Kikta, P., Korna, M., & McDaniel, J. (1982). *User's guide for COMBIMAN programs (Computerized Biomechanical Man-Model), Version 5* (AFAMRL-TR-81-151). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A116 281)

Bapu, P., Korna, M., & McDaniel, J. (1983). *User's guide for COMBIMAN programs (Computerized Biomechanical Man-Model), Version 6* (AFAMRL Technical Report 83-097). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A139 139)

Bates, F. J., Jr., Evans, S. M., Krause, H. E., & Luming, H. (1976). *Three dimensional display of the COMBIMAN man-model and work space* (AMRL Technical Report 74-15). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A027 175)

Beamon, W. S., Snyder, M. S., & Snyder, H. L. (1975). *An experimental evaluation of the spot wobble method of suppressing raster structure visibility* (AMRL Technical Report 75-63). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A018 566)

MEASURING A SUBJECT'S GRASP-REACH ENVELOPE

Subject reaching along a 30-degree line in the left 15-degree plane in a study to determine the 5th, 50th, and 95th percentile grasping-reach envelopes in three dimensions for men and women. The data were collected to serve as a guide to the placement of critical hand-operated controls for the seated operator. The work was done by Kenneth W. Kennedy under Workunit 71840832, "Design and Evaluation of Work Stations." AMRL-TR-77-50 (1978)

Bermudez, J. M., Schwank, J. C. H., Longridge, T. M., Smith, B. A., & McCloy, T. M. (1979). *Effect of peripherally presented visual signals on pilot performance during flight simulation* (AMRL Technical Report 78-120). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A073 604)

Boff, K. R. (1982). Critical research issues on cockpit applications of 3-D displays. *Proceedings of the National Academy of Sciences.*

Boff, K. R. (1982). Integrated perceptual information for designers. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON),* 1, 430-434.

Boff, K. R., & Calhoun, G. L. (1983). Research requirements for advanced aircrew 3-D displays. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON).*

Boff, K. R., Calhoun, G. L., & Lincoln, J. (1984). Making perceptual and human performance data an effective resource for designers. *NATO DGR Workshop (Panel IV): Weapon System Development Process and Technology Transfer.* Shrivenham, England: Royal College of Science.

Boff, K. R., & Martin, E. (1980). Aircrew information requirements in simulator display design: The integrated cueing requirements study. *Proceedings of the 2nd Inter-Service/ Industry Training Equipment Conference,* 355-362.

Brandt, W. E. (1977). *Program documentation for the T4 EWO crew station simulation programs* (AMRL Technical Report 77-6). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A037 944)

Brandt, W. E., Jr. (1976). *Program documentation for the bimodal short-term recognition memory program* (AMRL Technical Report 76-36). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A025 745)

Brandt, W. E., Jr., & Aldrich, K. A. (1978). *Program documentation for the terrain and flight dynamics program* (AMRL Technical Report 78-35). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A056 116)

Brandt, W. E., Jr., & Wartluft, D. L. (1975). *Program documentation for the DAIS triple task experiment program* (AMRL Technical Report 75-24). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A024 101)

Brandt, W. E., Jr., & Wartluft, D. L. (1975). *Program documentation for the phase VI EWO crew station simulation programs* (AMRL Technical Report 75-22). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A013 848)

Bridenbaugh, J., Kama, W. N., & Task, H. L. (1982). The helmet-mounted HUD: A change in design and applications approach for helmet-mounted displays. *AGARD Conference Proceedings No. 329.* Blackpool, UK. (NTIS No. AGARD-CP-329)

Brown, C. E., Jennings, L. S., & Ward, S. L. (1984). *Team problem solving: Leader proficiency, communication, and co-workers' functions* (AFAMRL Technical Report 84-056). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Buchroeder, R. A., Seeley, G. W., & Vukobratovich, D. (1981). *Design of a catadioptric VCASS helmet-mounted display* (AFAMRL Technical Report 81-133). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A109 431)

Calhoun, G. L., Arbak, C. J., & Boff, K. R. (1984). Eye-controlled switching for crew station design. *Proceedings of the Human Factors Society 28th Annual Meeting,* 258-262.

Cannon, M. W. (1979). *Contrast sensation: A linear function of stimulus contrast* (AMRL Technical Report 78-56). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A074 858)

Cannon, M. W., Jr. (1983). Contrast sensitivity: Psychophysical and evoked potential methods compared. *Vision Research, 23,* 87-95.

Chandler, R. F., Clauser, C. E., McConville, J. T., Reynolds, H. M., & Young, J. W. (1975). *Investigation of inertial properties of the human body* (AMRL Technical Report 74-137). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A016 485)

Chubb, G. P. (1977). *Modeling and analysis using SAINT: A combined discrete/continuous network simulation language* (AMRL Technical Report 77-78). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A075 396)

Chubb, G. P. (1978). *SAINT: A combined simulation language for modeling large complex systems* (AMRL Technical Report 78-48). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A058 040)

Chubb, G. P., & Berisford, K. M. (1977). *Manned system modeling: SAINT applied to strategic navigation* (AMRL Technical Report 76-105). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A129 877)

Churchill, E., & Kikta, P. (1977). *The AMRL anthropometric data bank library: Volumes I-V* (AMRL Technical Report 77-1). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A047 314)

Churchill, E., Kikta, P., & Churchill, T. (1978). *Intercorrelations of anthropometric measurements: A source book for USA data* (AMRL Technical Report 77-2). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A058 616)

Churchill, E., & McConville, J. T. (1976). *Sampling and data gathering strategies for future USAF Anthropometry* (AMRL Technical Report 74-102). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A025 240)

Churchill, E., Rabinow, D., & Erskine, P. (1979). Factor analysis of anthropometric data for fifteen race-age-national origin specific groups. In W. A. Stini (Ed.), *Physiological and Morphological Adaptation and Evaluation.* New York: Mouton.

Cohen, B. J. (1979). *Helmet-mounted displays: A computer-assisted analysis of day-night visual requirements* (AMRL Technical Report 79-62). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A072 061)

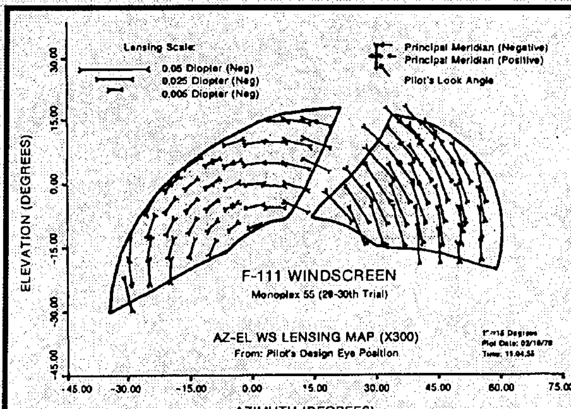
Cohen, B. J., Bloomfield, J. R., & McAleese, K. J. (1979). *Helmet mounted displays: An experimental investigation of display luminance and contrast* (AMRL Technical Report 79-60). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A072 059)

Cohen, B. J., & Levit, R. A. (1979). *The role of the upper field of view in selected HMS/D visual tasks* (AMRL Technical Report 79-65). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A072 064)

Cohen, B. J., & Markoff, J. I. (1979). *The presentation of different visual information to each eye* (AMRL Technical Report 79-66). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A072 065)

Connelly, E. M., Zeskind, R. M., & Chubb, G. P. (1977). *Development of a continuous performance measure for manual control* (AMRL Technical Report 76-24). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A041 676)

Corrick, G. E., & Scanlan, L. A. (1978). *Human performance evaluation of matrix displays* (AMRL Technical Report 78-110). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A080 120)



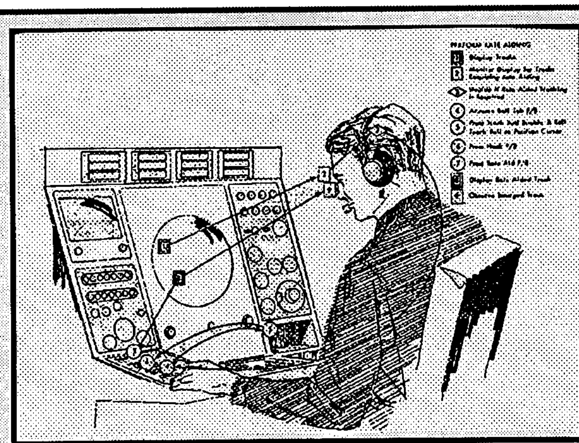
Measurements of lensing by an F-111 windscreen. AFAMRL-TR-81-67. (1981)

AN EXAMPLE OF WINDSCREEN OPTICAL DISTORTION

Illustration of the lensing produced by an F-111 windscreen in a study of windscreen distortion. The study was conducted in order to develop a computer analysis of the distortions to enable aiming correction for optical distortion in visually-coupled systems. The work was done by Major Rick Seid. AFAMRL-TR-81-67 (1981) (Task 718418)

A LINK-ANALYSIS SAMPLE

A sample link analysis extracted from a human engineering procedures guide by Charles W. Geer of the Boeing Aerospace Company developed under Workunit 71841212. AFAMRL-TR-81-35 (1981)



Corso, G., Kelly, S., & Bridges, D. (1983). *Binary classification and the subtractive approach* (AFAMRL Technical Report 83-050). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A137 716)

Courtright, J. F. (1981). *Effects of whole and partial body exposure to dry heat on certain performance measures* (AFAMRL Technical Report 80-43). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A100 305)

Courtright, J. F., & Kuperman, G. G. (1984). Use of SWAT in USAF System T&E. *Proceedings of the Human Factors Society 28th Annual Meeting*, 21-26.

Craig, J. L. (1984). Night formation/aerial refueling. *Proceedings of the Society of Automotive Engineers Fall Meeting.*

Craig, J. L. (1984). Night vision goggle/head-up display. *Proceedings of the Tri-Service Aeromedical Research Panel Fall Technical Meeting.*

Craig, J. L., & Simons, J. C. (1983). *Electroluminescent formation lights for HC-L30 P/N special operations: I. Flight test candidates* (AFAMRL Technical Report 83-069). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A137662)

Crawford, B. M. (1979). *Workload assessment methodology development* (AMRL Technical Report 79-120). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A081 032)

Crawford, B. M., Hoffman, M. S., & Pearson, W. H. (1978). *Multipurpose digital switching and flight control workload* (AMRL Technical Report 78-43). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A069 606)

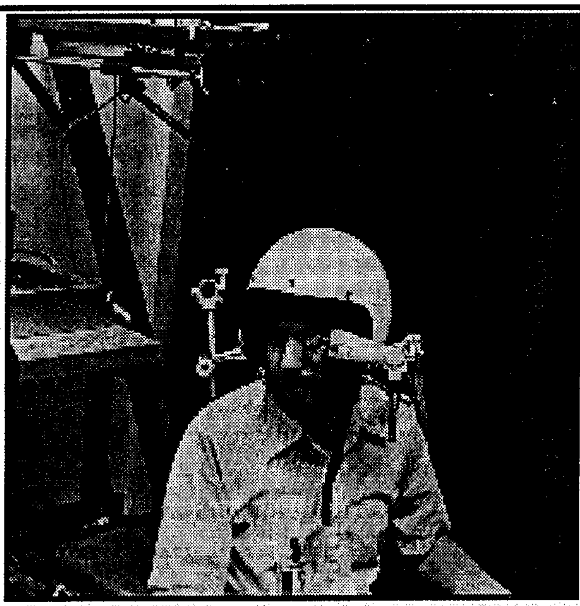
Crawford, B. M., Topmiller, D. A., & Kuck, G. A. (1977). *Man-Machine design considerations in satellite data management* (AMRL Technical Report 77-13). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A041 287)

Day, C. N. (1977). *Modern control applications to manual control - historical perspective and future direction* (AMRL Technical Report 77-82). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A054 922)

DeRego, P. J. (1984). A multipole model of the observed cerebral cortex magnetic field [Master's Thesis]. (Report No. AFIT/GE/ENG/84D-23). Wright-Patterson AFB, OH: Air Force Institute of Technology.

DeRuyck, A. R., & Kuipers, J. (1976). *An Extended-range Sensor Package (ESP)* (AMRL Technical Report 73-59). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A027 850)

Dobbins, J. P. (1976). *Variable-transmittance visor for helmet-mounted display* (AMRL Technical Report 74-28). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A027 177)



MEASURING THE PERFORMANCE OF A VISUALLY-COUPLED SYSTEM

Measuring head position and aiming accuracy in a visually-coupled system to examine the engineering interface. The work was done under Project 7184, Workunit 71842005 by Sheldon MacLeod of AMRL and David B. Coblintz of McDonnel Douglas. AMRL-TR-79-32 (1979)

Donaldson, E. (1983). *Preliminary investigation of variation in some dark adaptation aspects of possible relevance to military helicopter aircrew* (AFAMRL Technical Report 83-053). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A130 231)

Donohue-Perry, M. (1984). *Brightness comparison of electroluminescent versus incandescent lighting: A photometric validation* (AFAMRL Technical Report 84-036). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Duket, S. D., Wortman, D. B., & Seifert, D. J. (1976). *SAINT simulation of a remotely piloted vehicle/drone control facility: Technical documentation* (AMRL Technical Report 75-119). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A029 944)

Duket, S. D., Wortman, D. B., Seifert, D. J., Hann, R. L., & Chubb, G. P. (1978). *Analyzing SAINT output using SPSS* (AMRL Technical Report 77-64). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A058 723)

Duket, S. D., Wortman, D. B., Seifert, D. J., Hann, R. L., & Chubb, G. P. (1978). *Documentation for the SAINT simulation program* (AMRL Technical Report 77-63). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A059 198)

Eggemeier, F. T., Crabtree, M. S., Zingg, J. J., Reid, G. B., & Shingledecker, C. A. (1982). Subjective workload assessment in a memory update task. *Proceedings of the Human Factors Society 26th Annual Meeting.*

Eggemeier, F. T., McGhee, J. Z., & Reid, G. B. (1984). The effects of variations in task loading on subjective workload rating scales. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON).*

Evans, S. M. (1976). *User's guide for the programs of COMBIMAN (Computerized Biomechanical Man-Model)* (AMRL Technical Report 76-117). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A038 323)

Evans, S. M. (1978). *Updated user's guide for the COMBIMAN programs* (AMRL Technical Report 78-31). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A057 968)

Evans, S. M., Himes, M. J., Kikta, P. E., & Nearning, D. F. (1976). *Biomechanics and anthropometry for cockpit and equipment design* (AMRL Technical Report 77-7). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A037 020)

Felkey, M. A., Monk, D. L., & Stec, L. J. (1984). *The effect of jamming/deception on decision making* (AFAMRL Technical Report 84-055). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Flach, J. M., Snell, M. K., McMillan, G. R., & Warren, R. (1984). Dynamic seat tactual cuing can be superior to visual cuing (Abstract). *Bulletin of the Psychonomic Society.*

Freitag, M., Hilgendorf, R. L., & Searle, R. G. (1975). *The effect of simulated sun angle on air-to-ground target acquisition* (AMRL Technical Report 74-130). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A0ll 567)

Geer, C. W. (1981). *Human engineering procedures* (AFAMRL Technical Report 81-35). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A108 643)

Genco, L. V. (1982). *Angular deviation and its effect on HUD-equipped aircraft weapons sighting accuracy* (AFAMRL Technical Report 82-83). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A122 547)

Genco, L. V. (1983). Optical interactions of aircraft windscreens and HUDs producing diplopia. In W. L. Martin (Ed.), *Optical and human performance evaluation of HUD systems design* (Report No. AFAMRL-TR-83-095, pp. 20-27). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A140 601)

Genco, L. V., Eggleston, R. G., & Task, H. L. (1980). A portable transparency optical test system. *Proceedings of the Conference on Aerospace Transparencies.* London: Society of British Aerospace Companies.

Genco, L. V., Ginsburg, A. P., Self, H. C., Task, H. L., Lee, R. D., Schwartz, R. W., Wilson, W., & Coonrod, J. F. (Contributing Authors). (1983). In W. L. Martin (Ed.), *Optical and human performance evaluation of HUD systems design* (Report No. AFAMRL-TR-83-095,). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A140 601)

Genco, L. V., & Task, H. L. (1981). *Aircraft transparency optical quality — New methods of measurement* (AFAMRL Technical Report 81-21). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A096 183)

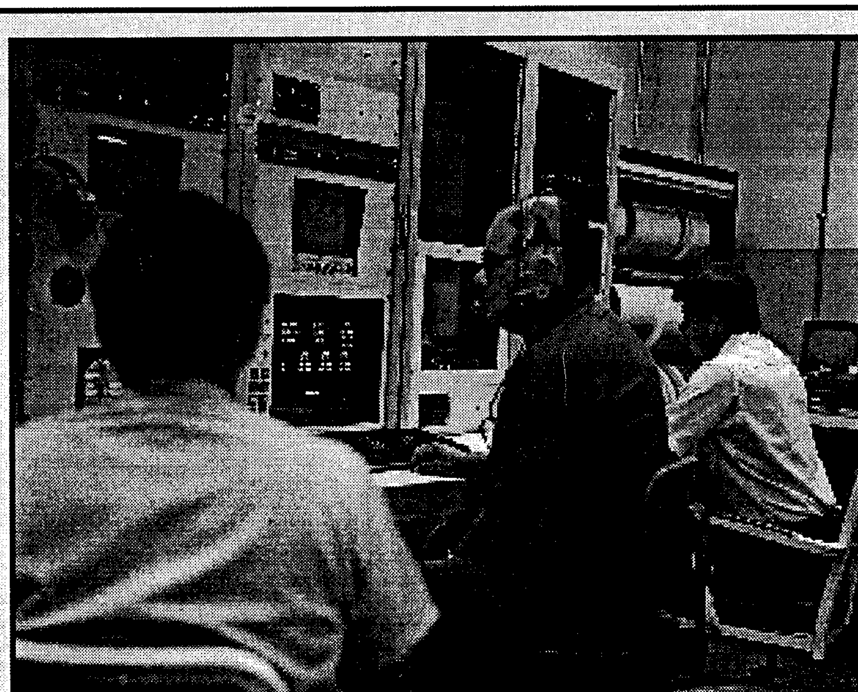
Genco, L. V., & Task, H. L. (1984). *Testing changes in visual function due to orbital environment* (AFAMRL Technical Report 84-049). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Ginsburg, A. P. (1978). *Visual information processing based on spatial filters contained by biological data* (AMRL Technical Report 78-129(I & II)). Wright-Patterson AFB, OH: Aero-space Medical Research Laboratory. (DTIC No. A090 117)

Ginsburg, A. P. (1981). *Proposed new vision standards for the 1980's and beyond: Contrast sensitivity* (AFAMRL Technical Report 80-121). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A116 296)

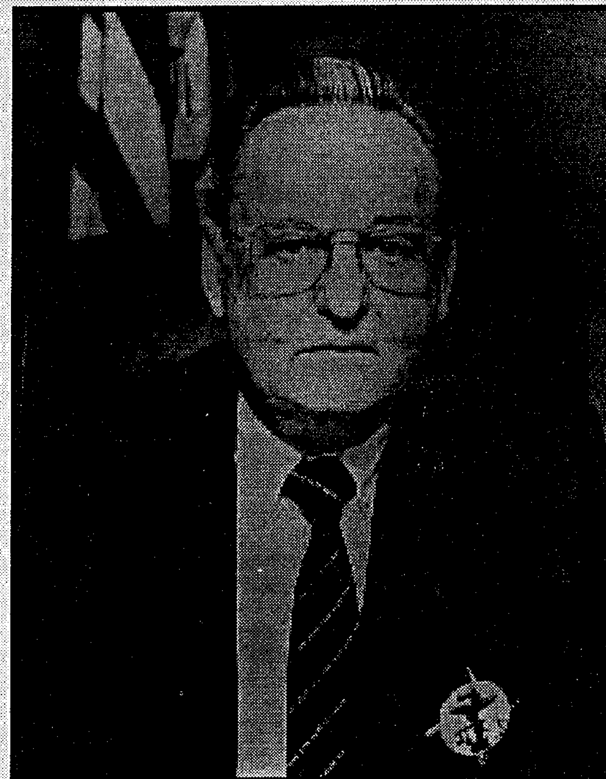
SUBJECT AT A SIMULATED B-52 WORKSTATION

MSgt Al Chapin of AMRL at a workstation in a simulation of the B-52 bomber's Offensive Avionics System (OAS). This simulator was used for several years by Earl Sharp and his associates in the Human Engineering Division to study the deficiencies of the system and provide suggestions for modifications and design improvements. This picture was taken in 1980. (Task 718410)



Charles Bates, Jr.
Chief, Human Engineering Division

1975 to 1991



Charles Bates, Jr., following a tour in the US Army Air Forces, received his Masters Degree in Industrial Psychology from Kansas State University. Subsequent graduate studies involved industrial training in side-looking radar and photo interpretation.

Starting in 1956, he engaged in research directly supporting Air Force weapon system development. After nearly 35 years of government service entirely devoted to the Armstrong Laboratory at Wright-Patterson Air Force Base, Ohio, Bates retired as Director of the Human Engineering Division of the Crew Systems Directorate.

Under Bates, the division performed research dealing with a wide range of human performance issues in Air Force systems, including programs in workload measurement, visually coupled systems, strategic aircraft crew station design evaluation, effects of microgravity on vision, cockpit design support technology and basic research in human visual performance.

Bates was a key factor in the success of many different projects during his career. From his start in the Crew and Systems Branch, he was involved in crew station design for the Snark, Atlas, Navaho, B-52, B-70, Skybolt, and Hound Dog Programs. Participation in the development and test activities of these programs led to a research project to quantify the contribution of the human component to system reliability.

In 1962, Bates was promoted to Chief, Performance Requirements Branch, where his primary responsibility was human engineering support of Air Force advanced system development, including analysis and experimental activity on human performance problems peculiar to advanced systems. Bates was project engineer for the human performance aspects of the Manned Orbiting Laboratory Program. His branch initiated the early work in visually coupled systems, including the development of the first airborne qualified helmet-mounted sight and helmet-mounted display, and provided the initial human performance data for multisensor and real-time reconnaissance program development. In 1975, Bates was promoted to Director of the Human Engineering Division and then selected for the rank of Senior Executive Service in August 1983.

Bates was the recipient of several performance and professional awards, including the Air Force Systems Command Distinguished Civilian Service Medal and the Presidential Meritorious Executive Rank Award. A past Chairman of the Aerospace Medical Panel of the Advisory Group for Aerospace Research and Development of the North Atlantic Treaty Organization, Bates held four patents in the areas of visually coupled systems and helmet-mounted displays.

Ginsburg, A. P. (1983). Direct performance assessment of HUD display systems using contrast sensitivity. In W. L. Martin (Ed.), *Optical and human performance evaluation of HUD systems design* (Report No. Air Force Aerospace Medical Research Laboratory-Technical Report-83-095, pp. 55-66). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A140 601)

Ginsburg, A. P., Martin, W. L., & Self, H. C. (1983). Contrast sensitivity performance assessment of HUD display systems. *Proceedings of the Second Symposium on Aviation Psychology.*

Gliatti, E. L., Martin, W. L., & Kuperman, G. G. (1977). *Imagery interpreter performance in the comparison of subjective estimates of photographic image quality* (AMRL Technical Report 77-38). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A061 160)

"As far as I know I am the only person to have done human experiments in the Thomas domes. Volunteers were exposed to low levels of carbon monoxide as they slept. They were in there for about ten hours—eight hours of sleep and two hours of performace tests. The reason for the study was that a report out of Stanford had stated that 50 parts per million affected performance. At that time the military limit was 100 parts per million per eight hour period, so they were concerned about performance decrements, as well as the possible need to make changes in workplaces and work shifts. We found no performance effect at all. We had essentially replicated the procedure of the Stanford scientist, so he rechecked his data and found an error. He retracted his findings. That was a big success for us."

— Robert O'Donnell, Chief
Workload and Ergonomics Branch
Human Engineering Division

Gomer, F. E., Spicuzza, R. J., & O'Donnell, R. D. (1976). Evoked potential correlates of visual item recognition during memory-scanning tasks. *Physiological Psychology, 4*, 61-65.

Gomer, F. E., Spicuzza, R. J., & O'Donnell, R. D. (1976). *Evoked potential correlates of visual item recognition during memory-scanning tasks* (AMRL Technical Report 74-141). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A027 808)

Graham, C., & Cook, M. R. (1984). *Effects of pyridostigmine on psychomotor and visual performance* (AFAMRL Technical Report 84-052). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Gutmann, J. C., Snyder, H. L., Farley, W. W., & Evans, J. E. (1979). *An experimental determination of the effect of image quality on eye movements and search for static dynamic targets* (AMRL Technical Report 79-51). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A077 728)

Hann, R. L. (1979). *Modality effects in scaling nonverbal information: Evidence for multiple memory codes* (AMRL Technical Report 79-53). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A072 297)

Hann, R. L., & Kuperman, G. G. (1975). SAINT model of a choice reaction time paradigm. *Proceedings of the Human Factors Society 19th Annual Meeting*, 336-341.

Harris, J. S., & Harding, K. G. (1981). *Study and evaluation of existing techniques for measuring aircraft windscreen optical quality: Development of new techniques for measuring aircraft windscreen optical distortion* (AFAMRL Technical Report 81-25). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A097 731)

Haywood, W. J., Jr., & McMahon, D. J. (1975). *Advanced helmet mounted sight study program* (AMRL Technical Report 73-10). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A007 874)

Heckart, S. A., Alexander, M., & McConville, J. T. (1977). Human engineering evaluation. In J. R. Weiss (Ed.), *Development test of the A/S 32K-4 Bomb Lift Truck* (ADTC Technical Report 77-41, pp. 28-37). Eglin AFB, FL: Armament Development and Test Center.

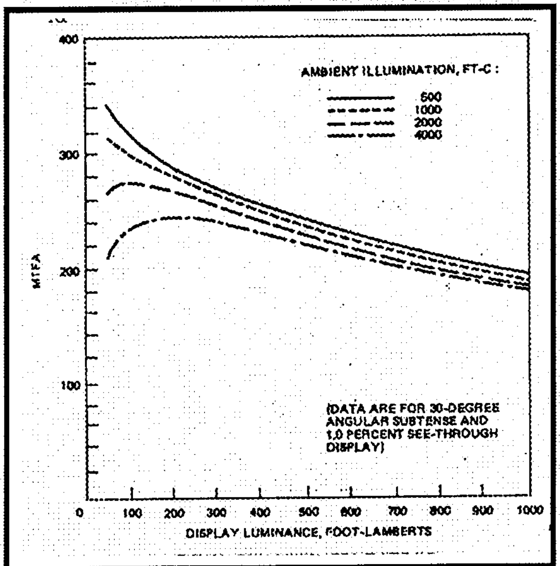
Heckart, S. A., & Kennedy, K. W. (1979). Human engineering evaluation of the aerial stores lift truck. In F. B. Atkinson (Ed.), *Development test and evaluation of Aerial Stores Lift Truck (ASLT) A/S 32K-8* (ADTC Technical Report 79-5, pp. 64-72). Eglin AFB, FL: Armament Development and Test Center.

Herron, R. E., Cuzzi, J. R., & Hugg, J. (1976). *Mass distribution of the human body using biostereometrics* (AMRL Technical Report 75-18). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A029 402)

Hershberger, M. L., & Guerin, D. F. (1975). *Binocular rivalry in helmet-mounted display applications* (AMRL Technical Report 75-48). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A013 838)

Hoffman, M. S., & Chubb, G. P. (1980). *Sampling methodology developed for preliminary SACDEF study* (AMRL Technical Report 78-33). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A083 091)

Hornseth, J. P., McMurry, R. L., Monk, D. L., & Porterfield, J. L. (1978). *Two dimensional eye tracking, sampling rate of forcing function* (AMRL Technical Report 78-26). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A058 896)



THE MODULATION TRANSFER FUNCTION OF A DISPLAY

Modulation transfer function area (MTFA) as a function of display luminance and ambient illumination. This graph, from "Binocular Rivalry in Helmet-Mounted Display Applications" is one of several graphs in this research study done for AMRL by M.L. Hershberger and D.F. Guerin of the Hughes Aircraft Company. This study is one of many conducted over a period of several years by various organizations in support of the Human Engineering Division's extensive research and development program on helmet-mounted display systems. AMRL-TR-75-48 (1975) (Task 718411)

Howland, B., Ginsburg, A., & Campbell, F. (1977). *High-pass spatial frequency letters as clinical optotypes* (AMRL Technical Report 77-88). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A072 889)

Jex, H. R., Magdaleno, R. E., Jewell, W. F., Junker, A., & McMillan, G. (1981). *Effects on target tracking of motion simulator drive-logic filters* (AFAMRL Technical Report 80-134). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Kaleps, I., Clauser, C. E., Young, J. W., Chandler, R. F., Zehner, G. F., & McConville, J. T. (1984). Investigation into the mass distribution properties of the human body and its segments. *Ergonomics, 27*(12), 1225-1237.

Kama, W. N. (1980). *Human operator interface with FLIR displays* (AMRL Technical Report 79-114). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A086 284)

Kama, W. N. (1983). Visual perception through windscreens: Effects of minor occlusions and haze on operator performance. In S. A. Marolo (Ed.), *Conference on Aerospace Transparent Materials and Enclosures* (Report No. AFWAL-TR-83-4154). Wright-Patterson AFB, OH: Air Force Wright Aeronautical Laboratories.

Kama, W. N., & Genco, L. V. (1982). *The effect of size and number (density) of minor optical occlusions on target detection performance* (AFAMRL Technical Report 82-48). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A122 546)

Kama, W. N., Genco, L. V., Barbato, M. H., & Hausmann, M. A. (1983). *The effect of haze on an operator's visual field and his target detection performance* (AFAMRL Technical Report 83-066). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A138 330)

Kama, W. N., Kuperman, G. G., Tutin, M. B., & Green, T. B. (1984). *The effectiveness of Radar Corner Reflectors (RCR) as a deception technique* (Report No. AFAMRL-TR-84-034). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Kama, W. N., Martin, W. L., & Kuperman, G. G. (1976). The effects of HUD symbology size on operator performance under various luminance conditions. *Proceedings of the 5th Psychology in the Air Force Symposium.* Colorado Springs, CO: USAF Academy.

Kama, W. N., Martin, W. L., & Kuperman, G. G. (1979). *Interim summary report of display working group joint DARCOM/NMC/AFLC/AFSC panel on the field of night vision technology* (AMRL Technical Report 79-101). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A077 061)

Karl, A. A., Buehring, W. J., McMillan, G. R., & Kissen, A. T. (1977). A head enclosure for exposing monkeys to selected gas mixtures. *Laboratory Animal Science, 27,* 267-270.

Karl, A. A., McMillan, G. R., Ward, S. L., Kissen, A. T., & Souder, M. E. (1978). Effects of increased ambient CO_2 on brain tissue oxygenation and performance in the hypoxic rhesus. *Aviation, Space, and Environmental Medicine, 49*(8), 984-989.

Karl, A. A., Ward, S. L., Souder, M. E., Kissen, A. T., McMillan, G. R., & Clauser, G. L. (1979). Rhesus brain gas tension and learned task performance responses to normoxic and hyperoxic breathing. *Preprints of the 1979 Annual Scientific Meeting of the Aerospace Medical Association* (pp. 189-190). Washington, DC: Aerospace Medical Association.

Keesee, R. L. (1976). *Prediction of modulation detectability thresholds for line-scan displays* (AMRL Technical Report 76-38). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A035 735)

Kelly, S. (1984). *Choice reaction time and color. An annotated bibliography* (AFAMRL Technical Report 84-022). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Kennedy, K. W. (1976). *International anthropometric variability and its effects on aircraft cockpit design* (AMRL Technical Report 72-45). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A027 801)

Kennedy, K. W. (1978). *Reach capability of men and women: A three-dimensional analysis* (AMRL Technical Report 77-50). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A060 312)

Kikta, P., & Churchill, T. (1978). *Editing procedure for anthropometric survey data* (AMRL Technical Report 78-38). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A060 393)

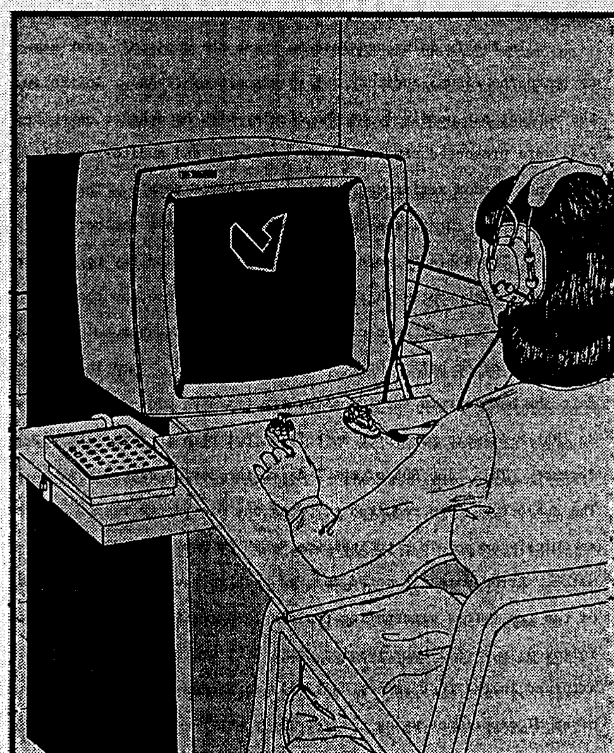
Kissen, A. T., Alexander M., Smedley, D. C., Buehring, W. J., Ward, S. L., & Lowe, D. H. (1976). *Evaluation of a face cooling device integrated with the standard HGU-type USAF flight helmet* (AMRL Technical Report 76-71). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A036 276)

Kissen, A. T., Summers, W. C., Buehring, W. J., Alexander, M., & Smedley, D. C. (1976). *Head and neck cooling by air, water, or air plus water in hyperthermia* (AMRL Technical Report 75-38,). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A027 614)

Kocian, D. F. (1975). *Investigation of a strap-on visual display for deaf lipreaders.* Unpublished master's thesis, The Ohio State University.

Kocian, D. F. (1976). *A Visually-Coupled Airborne Systems Simulator (VCASS): An approach to visual simulation* (AMRL Technical Report 77-31). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A039 999)

Korna, M., & Aume, N. (1980). *Designer's guide for the panel program* (AFAMRL Technical Report 80-124). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A093 989)



EVALUATING MODALITY EFFECTS IN SCANNING NONVERBAL INFORMATION

Sketch of a subject using a computer display in a study measuring modality effects in scanning nonverbal information to obtain evidence for multiple memory codes. The work was performed under Workunit 71841407 by Reuben L. Hann. AMRL-TR-79-53 (1979)

Kou, R. S., & Glass, B. C. (1979). *Development of observer model for AAA tracker response* (AMRL Technical Report 79-77). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A080 972)

Kou, R. S., Glass, B. C., Moran, M. S., & Vikmanis, M. M. (1979). *Development of MTQ tracker model and identification of model parameters* (AMRL Technical Report 79-80). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A080 807)

Kou, R. S., Glass, B. C., & Vikmanis, M. M. (1979). *Reduced-order observer model for AAA tracker response* (AMRL Technical Report 79-79). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A080 932)

Kraft, C. L., & Anderson, C. D. (1977). *Stereo acuity and reconnaissance: Phase II* (AMRL Technical Report 77-34). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 043 258)

Kraft, C. L., Anderson, C. D., Elworth, C. L., & Larry, C. (1977). *Windshield quality and pilot performance* (AMRL Technical Report 77-39). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A048 457)

Kroemer, K. H. E. (1975). *Human force capabilities for operating aircraft controls at 1, 3, and 5 Gz* (AMRL Technical Report 73-54). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A011 545)

Kroemer, K. H. E. (1976). *Effects of high G on pilot muscle strength available for aircraft control operation* (AMRL Technical Report 73-22). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A027 802)

"We have a fairly broad program in our division that is built on the foundation that Paul Fitts had laid when he first formed the organization 40 years ago. Much of his original work dealt with the solution of operational problems that he found occurred during World War II. From that work he developed general design principles that were then, in turn, translated into standard design practice, some of which are still in use today. The systems he worked on were comparatively very crude compared to the design challenges today; however, the basic paradigm still works."

—C. Bates, May 1985, "Human Engineering, Yesterday and Today," Civilian Employees Reporter

Kulwicki, P. V. (1976). *Influence of aircraft angle of attack on high G cockpit design* (AMRL Technical Report 75-124). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A025 083)

Kulwicki, P. V. (1978). *Research on visual display integration for advanced fighter aircraft* (AMRL Technical Report 78-97). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A069 605)

Kulwicki, P. V., & Sinnett, J. M. (1975). *Advanced maneuverability options for future fighters* (AMRL Technical Report 74-140). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A008 497)

Kuperman, G., Kettlewell, J., Kama, W. N., & Fraggiotti, J. (1977). *Research and simulation in support of near real/real time reconnaissance RPV systems* (AMRL Technical Report 77-33). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A044 598)

Kuperman, G. G. (1980). Evaluation of an image quality assessment technique based on magnification. *Proceedings of the Seventh Psychology in the Department of Defense Symposium.* Colorado Springs, CO: USAF Academy.

Kuperman, G. G. (1980). *Investigation of photographic image quality estimators* (AFAMRL Technical Report 80-27). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A087 805)

Kuperman, G. G. (1980). *Sensor-aided target acquisition simulation studies* (AMRL Technical Report 79-118). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A083 949)

Kuperman, G. G. (1982). *Systems performance and survivability considerations for tactical target recognition* (AFAMRL Technical Report 81-60). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A122 431)

Kuperman, G. G. (1984). Criteria for selecting subjects for the assessment of advanced crew system concepts. *Proceedings of the Ninth Psychology in the Department of Defense Symposium* (Report No. USAFA TR-84-2). Colorado Springs, CO: USAF Academy. (DTIC No. P003354)

Kuperman, G. G., Burns, R. K., & DeFrances, A. J. (1980). Human factors and terrain map display design. *Society for Information Display International Symposium: Digest of Technical Papers.*

Kuperman, G. G., & DeFrances, A. J. (1979). *Airborne electronic terrain map system: A literature review* (AMRL Technical Report 79-92). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A079 402)

Kuperman, G. G., DeFrances, A. J., & Sander, D. L. (1980). Information requirements for airborne electronic terrain maps. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON).*

Kuperman, G. G., & Gliatti, E. L. (1980). A comparative application of two subjective image quality assessment methods. *Society of Photographic Scientists and Engineers 33rd Annual Conference.*

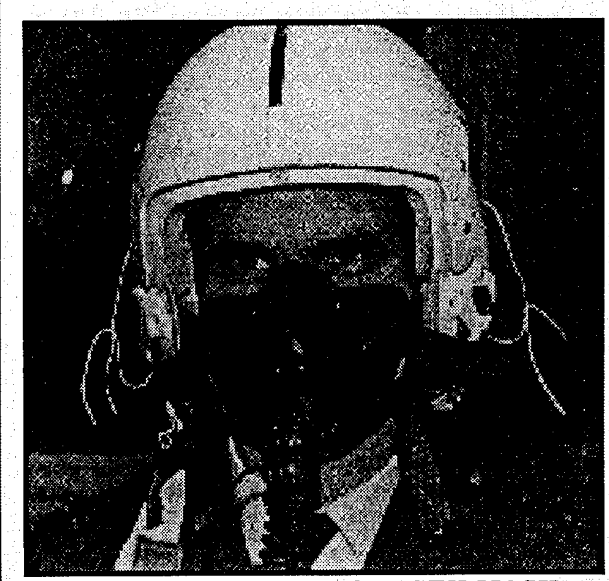
Kuperman, G. G., & Gliatti, E. L. (1981). A comparison of two subjective image quality methods. *Journal of Applied Photographic Engineering, 7*(1).

Kuperman, G. G., Hann, R. L., & Berisford, K. M. (1977). Refinement of a computer simulation model for evaluating DAIS display concepts. *Proceedings of the Human Factors Society 21st Annual Meeting.*

Kuperman, G. G., & Kama, W. N. (1978). Real time reconnaissance systems simulator. *Proceedings of the Society of Photo-Optical Instrumentation Engineers (SPIE): Visual Simulation & Image Realism, 162,* 146 - 156.

Kuperman, G. G., & Kulwicki, P. V. (1984). Mission scenarios for cockpit automation technology. *Proceedings of the 6th Digital Avionics Systems Conference,* 3-6.

Kuperman, G. G., Moss, R. W., & Bondurant, R. A. (1983). Crew system assessment methods applied to derivative fighter cockpits. *Proceedings of the Human Factors Society 27th Annual Meeting.*



SUBJECT WITH AN OXYGEN MASK IN TESTS FOR FITTING AND EVALUATION DATA

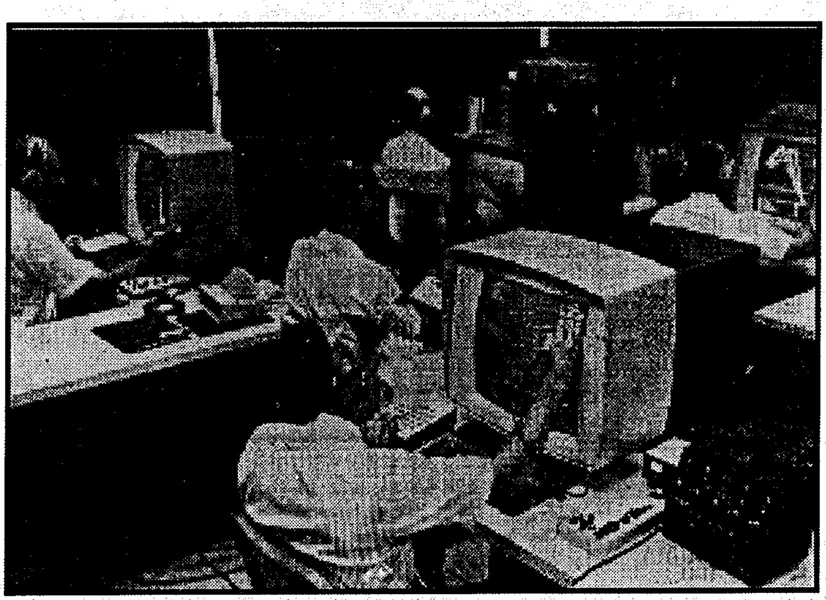
Front face view of a subject wearing an MBU-12/P oral-nasal oxygen mask in a study on the anthropometric sizing, fit-testing, and evaluation of this mask for air crew members. The work was done under Project 7184, Workunit 71840826. The researchers were Milton Alexander of AMRL and John T. McConville of Anthropology Research Project, Inc. AMRL-TR-79-44 (1979)

Kuperman, G. G., & Seifert, D. J. (1975). Development of a computer simulation model for evaluating DAIS display concepts. *Proceedings of the Human Factors Society 19th Annual Meeting.*

Kuperman, G. G., Wallquist, D. L., & Katz, L. (1984). A digital image processing facility for human factors research. *Proceedings of the Human Factors Society 28th Annual Meeting*

Laubach, L. L. (1975). *Muscular strength of women and men: A comparative study* (AMRL Technical Report 75-32). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A025 793)

Laubach, L. L. (1976). *Comparative muscular strength of men and women: A review of the literature* (AMRL Technical Report 75-120). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A072 892)



MULTIPLE OPERATORS CONTROLLING A REMOTELY PILOTED VEHICLE

Multiple operators in a simulation of remotely operated vehicles in a study designed to examine control smoothing and automatic heading correction. The work was done under Workunit 71841402 by Robert G. Mills, Robert F. Bachert, and Nilss M. Aume. AMRL-TR-75-87 (1975)

Laubach, L. L., & Alexander, M. (1975). Arm-reach capability of USAF pilots as affected by personal protective equipment. *Aviation, Space and Environmental Medicine, 46*(4), 377-386.

Leupp, D. G. (1983). *Aces II negative Gz restraint investigation* (AFAMRL Technical Report 83-049). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research. (DTIC No. A140 326)

Levison, W. H. (1983). *Development of a model for human operator learning in continuous estimation and control tasks* (AFAMRL Technical Report 83-088). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Levison, W. H., & Junker, A. M. (1977). *A model for the pilot's use of motion cues in roll-axis tracking tasks* (Report No. AMRL-TR-77-40). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Levison, W. H., McMillan, G. R., & Martin, E. A. (1984). Models for the effects of g-seat cuing on roll-axis tracking performance. *Proceedings of the 20th Annual Conference on Manual Control* (pp. 735-751). Moffett Field, CA: NASA Ames Research Center. (NASA Conference Publication 2341)

Lewis, D. E. (1983). *Feasibility demonstration of a target cuer simulator* (AFAMRL Technical Report 83-084). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A138 344)

Lewis, D. E. (1984). *Two-dimensional Fast Fourier Transforms in image processing* (AFAMRL Technical Report 84-006). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A139 997)

Lewis, D. E., & Kuperman, G. G. (1980). Non-conventional application of longitudinal tape recording to simulation of cued sensor imagery. *Journal of Applied Photographic Engineering, 6*(5).

Lewis, D. E., & Kuperman, G. G. (1980). Target cuer simulator with variable image speed. *Society for Information Display International Symposium: Digest of Technical Papers.* San Diego, CA.

Lewis, W. N., Close, D. H., Cook, L. G., & Jacobs, R. S. (1977). *Diffraction optics study* (AMRL Technical Report 76-119). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A043 632)

MacLeod, S. (1977). *Identification of alphabetic symbols as a function of their location in the visual periphery* (AMRL Technical Report 77-37). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A049 345)

MacLeod, S., & Coblintz, D. B. (1979). *Visually Coupled System-Computer Generated Imagery (VCS-CGI) engineering interface* (AMRL Technical Report 79-32). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A080 931)

MacLeod, S., & Eggleston, R. G. (1980). *Pilot reactions to optical defects found in F-111 bird impact resistant windscreens* (AFAMRL Technical Report 80-4). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A093 937)

MacLeod, S., & Martin, W. L. (1977). *Performance on a reciprocal tapping task with variations in intertapping interval* (AMRL Technical Report 77-49). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A055 145)

Mallory, W. R., & Task, H. L. (1981). Dynamic spatial filter for optical signal processing using a liquid crystal light valve. *Proceedings of the Society of Photo-Optical Instrumentation Engineers (SPIE).* San Diego, CA.

Martin, E. A., & McMillan, G. R. (1982). Development of a g-seat roll-axis drive algorithm [Abstract]. *Proceedings of the 18th Annual Conference on Manual Control* (Report No. AFWAL-TR-83-3021, pp. 165). Wright-Patterson AFB, OH: Air Force Wright Aeronautical Laboratories.

Martin, E. A., & McMillan, G. R. (1983). Validation of a g-seat roll-axis drive algorithm (Summary). *Proceedings of the 19th Annual Conference on Manual Control* (pp. 419-421). Cambridge, MA: Massachusetts Institute of Technology.

Martin, W. L. (1979). *Optical power spectrum analysis of processed imagery* (AMRL Technical Report 79-29). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A073 083)

Martin, W. L., & Task, H. L. (1976). *Human factors design criteria for liquid crystal displays* (Report No. AMRL-TR-76-48). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A030 823)

Martin, W. L., & Task, H. L. (1976). *Matrix element display devices and their application to airborne weapon systems* (AMRL Technical Report 76-49). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A027 449)

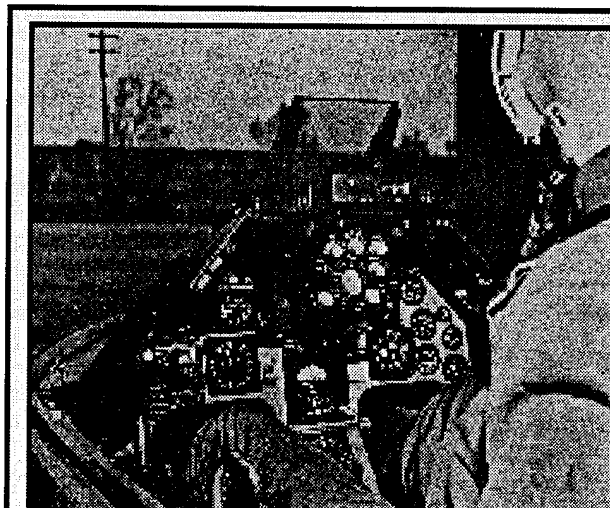
Martin, W. L., Task, H. L., Woodruff, K. R., & Pinkus, A. R. (1976). *Element density and percent active area design requirements for liquid crystal displays* (AFAL Technical Report 75-235). Wright-Patterson AFB, OH: Air Force Avionics Laboratory. (DTIC No. A024025)

McConville, J. T., & Alexander, M. (1975). Anthropometric sizing program for oral-nasal oxygen masks based on 1967 U.S. Air Force survey data. *Aviation, Space, and Environmental Medicine.*

McConville, J. T., & Churchill, E. (1976). *Statistical concepts in design* (AMRL Technical Report 76-29). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A025 750)

McConville, J. T., Churchill, E., & Clauser, C. E. (1977). *The Aerospace Medical Research Laboratory's anthropometric data bank: A resource for designers* (AMRL Technical Report 79-42). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A069 195)

McConville, J. T., & Clauser, C. E. (1977). *Comparative anthropometry of Air Standardization Coordinating Committee personnel for equipment designing: Helmets* (AMRL Technical Report 77-77). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A052 893)



TESTING A HOLOGRAPHIC HEAD-UP DISPLAY (HUD)

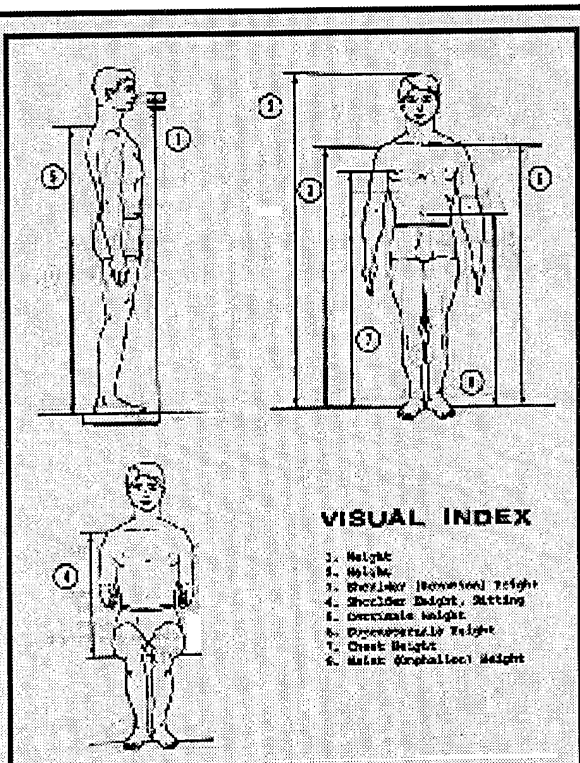
Testing a pilot in the cockpit of a YF-16 aircraft looking through the head-up display (HUD) in a study of diffractive optics. The goal was to determine the utility of both reflective and transmissive holographic optical elements for extending the information display capability of fighter aircraft. The study was done on contract under Workunit 71840448 by W. N. Lewis, D.H. Close, J.G. Cook and R.S. Jacobs of the Hughes Aircraft Company. AMRL-TR-76-119 (1977)

McConville, J. T., & Clauser, C. E. (1978). *Anthropometric resources vs civilian needs* (AMRL Technical Report 78-111). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A061 390)

McConville, J. T., Tebbetts, I., & Alexander, M. (1979). *Guidelines for fit testing and evaluation of USAF personal-protective clothing and equipment* (AMRL Technical Report 79-2). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A065 901)

McDaniel, J. W. (1976). Computerized biomechanical man-model. *Proceedings of the International Ergonomics Association.*

McDaniel, J. W. (1977). Aerospace Medical Research Laboratory's pilot strength and endurance screening program. *Proceedings of the 48th Annual Scientific Meeting of the Aerospace Medical Association.*



MEASUREMENTS USED IN A HEIGHT-WEIGHT SIZING MANUAL

Some of the 71 different measurements taken for a revised height-weight sizing manual for protective flight garments. The work was done under Workunit 71840826 of Project 7184 by Milton Alexander, and by John McConville and Ilse Tebbetts of Anthropology Research Project, Inc. AMRL-TR-79-28 (1979)

In 1983, the Strategic Air Command asked my group to build a simulator facility for the new B-1 bomber, which was under construction, but for which there was no training device. We built them two simulators to serve as interim trainers while the production trainers were being produced. While these were being fielded, we built another, higher fidelity, defensive simulator and began a similar operation for the B-1 as we had done for the B-52. Later the two fielded units were returned to the lab and served as experimental platforms for all B-1 crew positions. This group is now working on a similar device for the B-2.

— Earl Sharp. Program Engineer
Human Engineering Division

McDaniel, J. W. (1978). *Aerospace Medical Research Laboratory's pilot strength and endurance screening program* (AMRL Technical Report 78-112). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A061 706)

McDaniel, J. W. (1981). *Male and female capabilities for operating aircraft controls* (AFAMRL-TR-81-39). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A098 256)

McDaniel, J. W. (1982). Biomechanical computer modeling for the design and evaluation of workstations. In R. Easterby, K. H. E. Kroemer, & D. F. Chaffin (Eds.), *Anthropometry and biomechanics theory and application.* New York: Plenum Press.

McDaniel, J. W. (1984). CREW CHIEF: Techniques for maintenance and workplace evaluation. *Proceedings of the NATO Defense Research Group Panel VIII: Applications of System Ergonomics to Weapon System Development* (pp. 25-26). England: Royal Military College of Science.

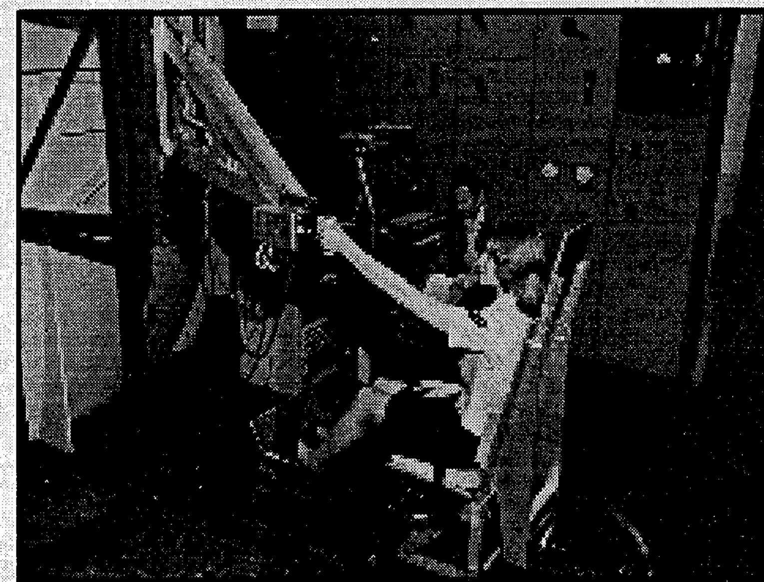
McDaniel, J. W., Skandis, R. J., & Madole, S. W. (1983). *Weight lift capabilities of Air Force basic trainees* (AFAMRL-TR-83-0001). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A129 543)

McGillem, C. D., & Aunon, J. I. (1979). *Analysis of single event evoked potentials* (AMRL Technical Report 79-83). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A080 896)

McMillan, G. R., Cody, W. J., & Mills, R. G. (1983). Laboratory studies of aircrew chemical protective ensemble: Effects on pilots' performance. *AGARD Conference Proceedings No. 338: Sustained Intensive Air Operations: Physiological and Performance Aspects.* Paris: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-CP-338)

McMillan, G. R., & Crabtree, M. S. (1978). *Some effects of television sensor blooming on operator tracking performance and weapon system effectiveness* (Report No. AFAL-TR-77-57(1&11)). Air Force Avionics Laboratory: Wright-Patterson AFB, OH.

McMillan, G. R., Levison, W. H., & Martin, E. A. (1984). Motion simulation with a g-seat system: Sensory and performance mechanisms. *Proceedings of the Ninth Psychology in the Department of Defense Symposium* (Report No. USAFA-TR-84-2, pp. 158-162). Colorado Springs, CO: USAF Academy. (DTIC No. P003354)



MEASURING ISOMETRIC FORCE CAPABILITY FOR A FEMALE STRENGTH ATLAS

Dr. Joe McDaniel measuring a five-second isometric force exertion by an Air Force enlisted woman in one of the six directions and seventy-six handle locations used in compiling a strength atlas. (1978-1980) (Task 718408)

Meyer, E. G., Rickels, W. H., & Mills, R. G. (1983). *The user-assisted Automated Experimental (TEST) Design program (AED): Version II* (AFAMRL Technical Report 82-100). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A124 303)

Meyer, G. R. (1976). *Survey of computer software for the human engineering systems simulation facility* (AMRL Technical Report 71-61). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A028 301)

Miller, J. J., Jr. (1976). *Program documentation for the analog digitization program* (AMRL Technical Report 76-12). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A021 918)

Miller, J. J., Jr. (1977). *Program documentation for the head switching software package* (AMRL Technical Report 77-41). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A046 175)

Mills, R. G., Aume, N. M., & Bachert, R. F. (1975). *Report of AMRL Remotely Piloted Vehicle (RPV) system simulation study III results* (AMRL Technical Report 75-126). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A020 064)

Mills, R. G., Bachert, R. F., & Aume, N. M. (1975). *Summary Report of AMRL Remotely Piloted Vehicle (RPV) system simulation study II results* (AMRL Technical Report 75-13). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A006 142T)

Mills, R. G., Bachert, R. F., & Aume, N. M. (1975). *Supplementary report of RPV system simulation study. II: Evaluation of RPV position report smoothing and automatic heading correction* (AMRL Technical Report 75-87). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A017 334)

Mills, R. G., Bachert, R. F., & Hatfield, S. A. (1975). *Quantification and prediction of human performance: Sequential task performance reliability and time* (AMRL Technical Report 74-48). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A017 333)

TESTING AN OBSERVER AT A SIMULATED B-52 BOMB-NAVIGATION STATION

An observer working at the bomb-navigation station of a B-52 aircraft simulator in the Armstrong Laboratory. This station was part of the Offensive Avionics System (OAS) on the B-52. The Human Engineering Division performed human factors-oriented exercises with the system and conducted experiments and analyses of human and system behavior to obtain design recommendations for improving it. The work was done by Earl Sharp and coworkers in 1974-1976. (Task 718410)

Mills, R. G., Hutson, F. T., Hartman, W. B., Meyer, E. G., Hoyland, C. M., Navarro, H., & Covelli, R. R. (1981). *Evaluation of alternative video imagery processors in unjammed and jammed environments in terms of operator performance in a weapon delivery simulator* (AFAMRL Technical Report 81-45). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A105 222)

Moise, S. L. (1980). *Development of neurophysiological and behavioral metrics of human performance* (AFAMRL Technical Report 80-39). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A087 840)

Monk, D. L., & Jagacinski, R. J. (1983). *A test of Fitts' Law in two dimensions with hand and head movements* (AFAMRL Technical Report 83-054). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Monk, D. L., Porterfield, J. L., Hornseth, J. P., & McMurry, R. L. (1978). *Head tracking at large angles from the straight ahead position* (AMRL Technical Report 78-27). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A058 900)

Morrissette, J. O., Hornseth, J. P., & Shellar, K. (1975). Team organization and monitoring performance. *Human Factors, 17*(3), 296-300.

Mras, J., Brandt, W. E., Nagel, J. L., & Sebasky, G. M. (1978). *Program documentation for the helmet-mounted-display processor flight software* (AMRL Technical Report 78-36). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A063 312)

Mueller, L. J. (1979). *Helmet-mounted sight/display program: CESSNA 310 flight test* (AMRL Technical Report 79-59). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A072 058)

Muick, C. J. (1978). *Lexicon of aircraft transparency terms* (AMRL Technical Report 78-122). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A071 319)

Murray, R. D. (1983). The application of a superconducting quantum interference device second-order gradiometer to measure visual evoked responses [Master's Thesis]. (Report No. AFIT/GE/EE/83D-50). Wright-Patterson AFB, OH: Air Force Institute of Technology.

Nelson, D., & Ritchie, M. (1976). *Using computer-generated displays for research on synthesized displays: Distance perception aided by aerial perspective and texture* (AMRL Technical Report 76-34). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A030 589)

Newman, R. L. (1980). *Operational problems associated with head-up displays during instrument flight* (AFAMRL Technical Report 80-115). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A093 992)

DEVELOPING OPERATIONAL PROCEDURES FOR COMBIMAN

Susan M. Evans from the University of Dayton Research Institute working with a display used in developing a user's guide on operational procedures for the COMBIMAN program. The work was done under Workunit 71840824. COMBIMAN is the acronym for COMputerized Biomechanical MAN-model, a computer-generated manikin of the human body representing its various and variable dimensions and motion characteristics. COMBIMAN was developed earlier for the Human Engineering Division. This model has been revised several times since this report by Susan M. Evans. AMRL-TR-78-31 (1978)

O'Donnell, R. D., & Spicuzza, R. J. (1977). *Visually evoked brain potentials as aids in display design* (AMRL Technical Report 77-58). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A043 853)

Olson, B. A. (1979). *Operational pilot factors analysis report* (AMRL Technical Report 79-64). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A072 063)

Pantle, A. J. (1980). *Analysis of dynamic visual processing* (AFAMRL Technical Report 80-117). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A094 077)

Pantle, A. J. (1983). *Spatial contrast sensitivity with extremely small pupils* (AFAMRL Technical Report 83-092). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A141 970)

Pearson, W. H. (1980). *Studies in tactical display symbology: II. Symbol meaningfulness and learning efficiency* (AFAMRL Technical Report 80-115). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A093 952)

Pearson, W. H., Rundle, M., & Hoffman, M. S. (1979). *Studies in tactical symbology: I. Preferred tactical symbology for joint tactical information distribution system (JTIDS)* (AMRL Technical Report 78-115). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A070 706)

Pinkus, A. R. (1982). *The effects of color and contrast on target recognition performance using monochrome television displays* (Report No. AFAMRL-TR-82-9). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Post, D. L. (1984). CIELUV/CIELAB and self-luminous displays: Another perspective. *Color Research and Application, 9,* 244-245.

Post, D. L., & Sheibenberger, D. (1984). Angular subtense requirements for colored CRT symbology. *Proceedings of the Human Factors Society 28th Annual Meeting, 2,* 937-941.

Potter, E., Burkott, P., & Gordon, J. (1976). *Visually activated switch system* (AMRL Technical Report 76-70). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A031 589)

Pratt, P. D. (1976). *Advanced Helmet Sight Reticle Assembly (AHRA)* (AMRL Technical Report 73-11). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A039 057)

Price, J. (1979). *Visor fabrication process study* (AMRL Technical Report 79-63). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A072 062)

Prouhet, E. P., & Kulwicki, P. V. (1977). *High acceleration cockpit simulator evaluation summary report* (AMRL Technical Report 75-123). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A045 165)

Reid, G. B. (1980). An operational application of neurophysiological and behavioral workload indices. *Proceedings of the Human Factors Society 24th Annual Meeting.*

Reid, G. B., Eggemeier, F. T., & Nygren, T. E. (1982). An individual differences approach to SWAT scale differences. *Proceedings of the Human Factors Society 26th Annual Meeting.*

Reid, G. B., Eggemeier, F. T., & Shingledecker, C. A. (1982). Subjective workload assessment technique. In M. L. Frazier, & R. B. Crombic (Eds.), *Proceedings of the AAA Workshop on Flight Testing to Identify Pilot Workload and Pilot Dynamics.* Edwards AFB, CA: Air Force Flight Test Center.

Reid, G. B., Shingledecker, C. A., & Eggemeier, F. T. (1981). Application of conjoint measurement to workload scale development. *Proceedings of the Human Factors Society 25th Annual Meeting,* 522-526.

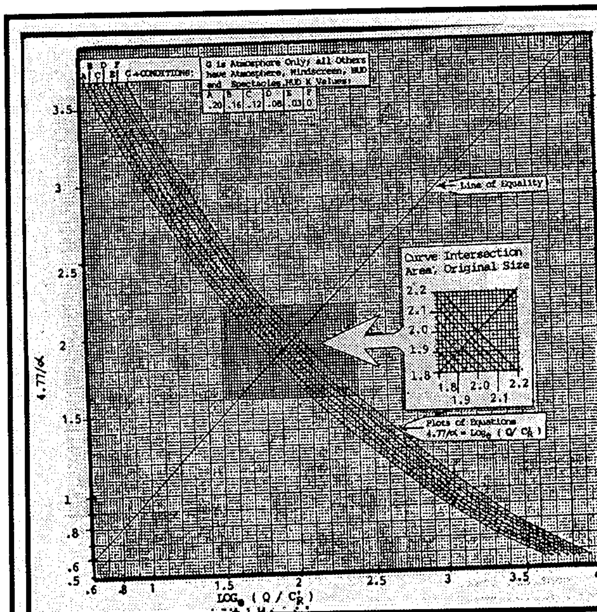
Reid, G. B., Shingledecker, C. A., Hockenberger, R. L., & Quinn, T. J. (1984). A projective application of the subjective workload assessment technique. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON).*

Repperger, D. W., & Junker, A. M. (1977). *Study of identification methods and structural modeling techniques on empirical data from a motion study* (AMRL Technical Report 77-45). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A041 856)

Reynolds, H. M. (1980). Three-dimensional kinematics in the pelvic girdle. *Journal of AOA, 80*(4).

Reynolds, H. M. (1983). *A foundation for systems anthropometry: Lumbar/pelvic kinematics* (AFAMRL Technical Report 83-016). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A129 517)

Rinalducci, E. J., Bertinuson, J., Caplan, R. D., Guion, R. M., King, V. M., Sliney, D. H., Smith, S. W., Snyder, H. L., Sommer, A., Stark, L. W., Task, H. L., & Taylor, H. R. (1983). *Video displays, work, and vision.* Washington, DC: National Academy Press.



CONTRAST LOSS DUE TO ATMOSPHERE, WINDSCREEN, AND SPECTACLES

One of the tutorial examples in a theory paper showing how to determine airborne contrast loss due to the atmosphere, the aircraft windscreen, and spectacles. A paper by Herschel C. Self; one of several papers in a joint AFAMRL-ASD (ENA) technical report edited by Wayne Martin. AFAMRL-TR-83-095 (1983) (Task 718418)

Robinette, K., & Churchill, T. (1979). *Design criteria for characterizing individuals in the extreme upper and lower body size ranges* (AMRL Technical Report 79-33). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A072 353)

Robinette, K., Churchill, T., & McConville, J. T. (1979). *A comparison of male and female body sizes and proportions* (AMRL Technical Report 79-69). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A074 807)

Robinette, K. M. (1983). *An annotated bibliography of United States Air Force Engineering Anthropometry - 1946 to 1983* (AFAMRL Technical Report 83-045). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A129 981)

Rolek, E. P. (1980). *SAM system performance evaluation: E-O data for human operator model development* (AFAMRL Technical Report 80-118). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A094 023)

Rouse, W. B., & Rouse, S. H. (1983). *A framework for research on adaptive decision aids* (AFAMRL Technical Report 83-082). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Scanlan, L. A., & Carel, W. L. (1976). *Human performance evaluation of matrix displays: Literature and technology review* (AMRL Technical Report 76-39). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A029 932)

Schindler, R. A. (1976). *Optical power spectrum analysis of display imagery. Phase I: Concept validity* (AMRL Technical Report 76-96). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A035 377)

Schindler, R. A., & Martin, W. L. (1978). *Optical power spectrum analysis of display imagery* (AMRL Technical Report 78-50). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A058 040)

Seeman, J. M., & Homstad, L. E. (1979). *Integrated helmet-mounted sight/display program* (AMRL Technical Report 79-61). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A072 060)

Seid, R. (1981). *Computer analysis and correction of the optical distortion in the F-111 bird impact resistant windscreen* (AFAMRL Technical Report 81-67). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Seid, R. C., & Self, H. C. (1978). *Influence of gridboard line width and spacing on windscreen distortion measurements* (AMRL Technical Report 78-93). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A065 821)

Seifert, D. J. (1979). *Combined discrete network: Continuous control modeling of man-machine systems* (AMRL Technical Report 79-34). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A072 376)

Seifert, D. J., Koeplinger, G., & Hoyland, C. M. (1980). *Redimen: SAINT redimensioning program* (AMRL Technical Report 80-5). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A082 735)

Seifert, D. J., Wortman, D. B., & Duket, S. D. (1977). *SAINT: A combined discrete/continuous network simulation technique* (AMRL Technical Report 77-24). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A039 586)

Self, H. C. (1978). *The behavior of observers in detecting unbriefed targets at different aircraft speeds with side-looking radar* (AMRL Technical Report 77-95). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A060 908)

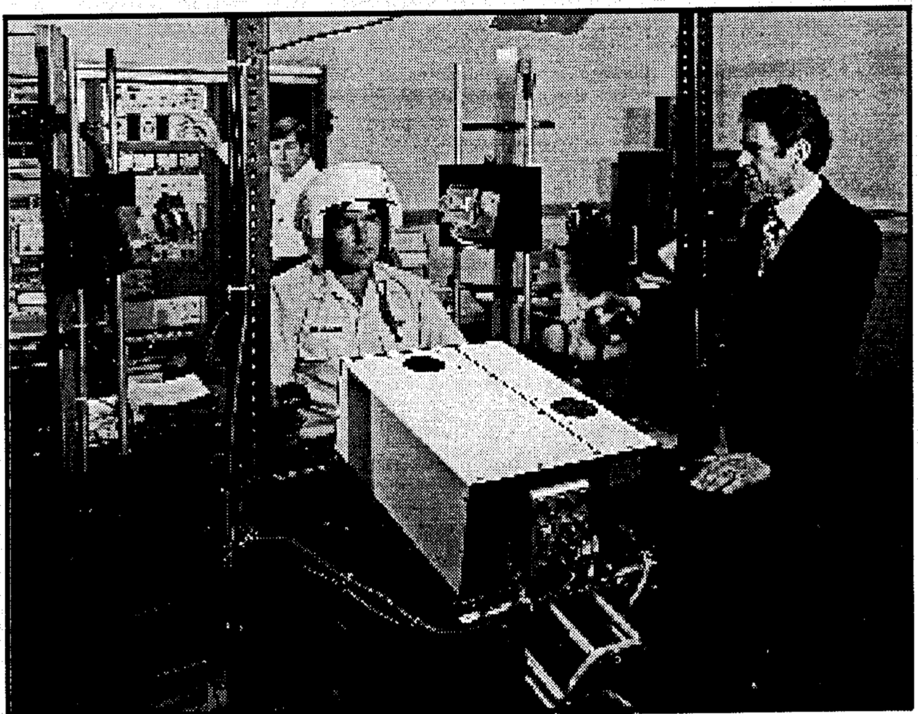
Self, H. C. (1979). *Detecting tactical targets with motion pictures from low slow aircraft* (AMRL Technical Report 79-31). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A074 808)

One of Earl Sharp's first projects on his newly developed B-52 EWO simulator was to redesign it based on available anthropometric data. This project was spurred by his observations that the crews were sometimes unable to reach or see important components of the workstation. Simply by applying an existing database of reach data with data about forces required to operate certain switches or knobs and dials, Earl came up with a more ergonomically sound workstation.

In order to test the new design concepts, Earl recruited crews to run as subjects in highly realistic mission scenarios which consisted of real mission briefings, the mission itself, and the debrief, to provide the crews with the most real experience possible. SAC provided the details of the up-to-date threat types from Vietnam (at the time) to challenge the crews and make them act as if they were really there. The crews reported that after about 30 minutes, they had forgotten they were in a simulator. They also reported that the realistic missions provided them with better training than some of the simulator training conducted in the wings.

Some of Earl's discoveries were frowned upon by SAC. Earl would discover what really went on in the aircraft rather than what doctrine dictated or what SAC thought was happening. He was able to guarantee the subjects' anonymity and confidentiality while they were being tested and so the crews acted as they would in the real aircraft. This brought credibility and respect to Earl's findings from the crews and SAC.

— Klein Associates
Interview with Earl Sharp



EYE TRACKING PERFORMANCE

Capt Al Dickson is the experimental subject, James L. Porterfield is the experimenter, and Don Monk is adjusting the equipment in an investigation of eye tracking performance with the Honeywell Remote Oculometer. This work was done in 1978.

Self, H. C. (1982). *Image size range and TV camera separation distance for large secure areas* (Report No. AFAMRL-TR-81-94). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A122 444)

Self, H. C. (1982). *Visual judgments of optical distortion in aircraft windscreens* (AFAMRL Technical Report 81-24). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. 1 124 307)

Self, H. C. (1983). Contrast loss and target detection. In W. L. Martin (Ed.), *Optical and human performance evaluation of HUD systems design* (Report No. AFAMRL-TR-83-095, pp. 31-54). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A140 601)

Self, H. C., & Heckart, S. A. (1979). *Daytime visual acuity of observers through a window with and without binoculars* (AMRL Technical Report 79-23). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A074 722)

Self, H. C., & Heckart, S. A. (1982). *Visual acuity with and without binoculars through thick observation tower windows* (AFAMRL Technical Report 81-95). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A114 916)

Self, H. C., & Task, H. L. (1980). *Potential of optical Fourier analysis for measuring windscreen distortion* (AFAMRL Technical Report 80-104). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A094 127)

Shingledecker, C. A., Crabtree, M. S., Simons, J. C., Courtright, J. F., & O'Donnell, R. D. (1980). *Subsidiary radio communications tasks for workload assessment in R&D simulations: I. Task development and workload scaling* (AFAMRL Technical Report 80-126). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A094 021)

Shirachi, D. K., Monk, D. L., & Black, J. H., Jr. (1976). *Effects of headgear and visual angle on head rotation spectral characteristics* (AMRL Technical Report 76-68). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A093 814)

Skelly, J. J., Rizzuto, A., & Wilson, G. F. (1984). Temporal patterning and selective attention effects on the human evoked response. In J. Gibbon, & L. Allan (Eds.), *Timing and Perception, Annals of New York Academy of Science, 423*, 646-649.

Skelly, J. J., & Wilson, G. (1983). Temporal context and instructional set effects on evoked potentials. *Proceedings of the 149th National Meeting of the American Association for the Advancement of Science.*

Smedley, D. C., & Nelson, D. R. (1979). *Effects of background illumination and target contrast on flashblindness recovery time* (AMRL Technical Report 79-30). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A071 906)

Snyder, H. L. (1976). *Visual search and image quality* (AMRL Technical Report 76-89). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A036 263)

Snyder, H. L., Dunsker, E. D., Beamon, W. S., & Gutmann, J. C. (1980). *An evaluation of the effect of spot wobble upon observer performance with raster scan displays* (AMRL Technical Report 79-91). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A083 090)

Stern, J., & Skelly, J. J. (1984). The eyeblink and workload considerations. *Proceedings of the Human Factors Society 28th Annual Meeting* 2, 942-944.

Stockman, G. C., & Kopstein, S. H. (1979). *The use of models in image analysis* (AMRL Technical Report 78-117). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A067 166)

Targove, B. D., & Seid, R. (1979). *Paraxial opticovisual analysis of the F-111E windscreen with generic application* (AMRL Technical Report 79-107). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A080 143)

Task, H. L. (1979). *An evaluation and comparison of several measurements of image quality for television displays* (AMRL Technical Report 79-7). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A069 690)

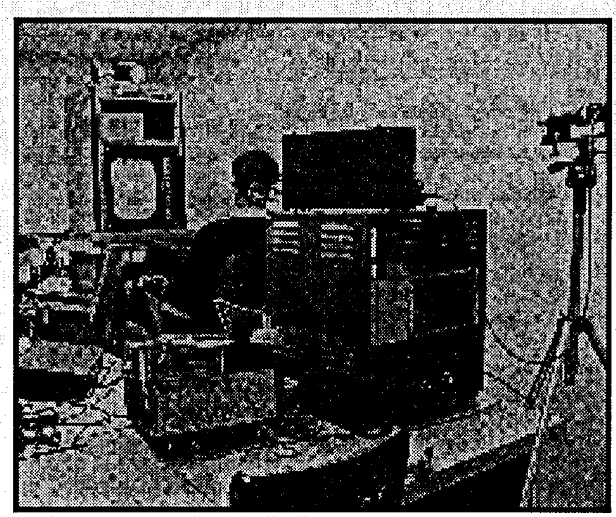
Task, H. L. (1979). *Raster-scan display photometric noise measurement* (AMRL Technical Report 79-13). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A073 024)

Task, H. L. (1983). Measurement of HUD optical quality. In W. L. Martin (Ed.), *Optical and human performance evaluation of HUD systems design* (Report No. AFAMRL-TR-83-095, pp. 11-19). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A140 601)

Task, H. L. (1983). Optical effects of F-16 canopy-HUD integration. In S. A. Marolo (Ed.), *Conference on Aerospace Transparent Materials and Enclosures* (Report No. AFWAL-TR-83-4154, pp. 809-824). Wright-Patterson AFB, OH: Air Force Wright Aeronautical Laboratories.

Task, H. L. (1984). Image quality measurement. In C. P. Gibson (Ed.), *Proceedings of the Workshop on Colour Coded vs Monochromatic Electronic Displays* (Report No. DS/A/DR(84)431, pp. 20.1-20.15). Farnborough, England: Royal Aircraft Establishment.

Task, H. L., Eggleston, R. G., & Genco, L. V. (1980). A new angular deviation measurement device for aircraft transparencies. *Proceedings of the Conference on Aerospace Transparencies.* London: Society of British Aerospace Companies.



TESTING FOR AN OBSERVER'S MODULATION DETECTABILITY THRESHOLD

A subject observing the display in a study of the modulation detectability thresholds for line-scan displays. This contract research was done for AMRL by Robin Keesee of the Virginia Polytechnic Institute and State University. AMRL-TR-76-38 (1976) (Project 7184)

Shortly after being assigned to the newly formulated Visual Display Systems Branch (May, 1974), under the direction of Thomas A. Furness, I was asked to consult with Avionics Laboratory personnel at WPAFB involved with detecting and monitoring the presence of satellites in deep space. By that time, there were sufficient pieces of disintegrated satellites, as well as functional satellites launched by this country and others, that the Avionics Laboratory, in conjunction with Lincoln Labs, was proposing to build GEODSS (Ground Electro-Optical Deep Space Surveillance System), a satellite detection, tracking, and cataloging system. The plan was to build a few tracking stations at selected sites around the globe which would house high-powered telescopes, slaved to the movement of the starfield, having very sensitive TV cameras at the image plane. The video information was to be displayed on high-resolution displays which would be monitored by operators who would identify anything that moved as either a satellite or noise. Problems of vigilance and visual differentiation between a real satellite and artifacts of electronic noise were mixed with boredom and visual fatigue to produce a very challenging human task.

A short time earlier, Larry Scanlan at the University of Illinois at Urbana-Champaign had produced a PhD dissertation on "time compression" under the contractual support of the Air Force Office of Scientific Research. His research, and that of C.T. White of the Naval Electronics Laboratory, nearly 20 years earlier, demonstrated greatly improved target detection performance using the coherent motion cues provided by a time-compressed display. White had filmed successive scans of a radar display and projected them back at a standard movie frame rate, thus making the coherence of target movement much more apparent. Scanlan used a computer-driven plasma panel display to generate the stimulus material and explored the effects of various time-compression ratios and number of stored frames on detection time.

An inexpensive dual-screen black and white TV had just come on the commercial market, having approximately five-inch and eight-inch screens, together with a "one-shot memory" video disk for recording and displaying on the smaller screen, single frames of video for study by sports enthusiasts. We bought seven of these devices, and had the video disks pulled out of them and wired so as to be able to manipulate the time between stored frames, the number of times a stored frame was displayed before the next one was presented, and the number of frames stored. Bill Kama and I (with the help of Maryann Howes of SRL) were in the process of generating experimental stimulus materials using a satellite/starfield simulator the Avionics Laboratory had fabricated, in which sky background, satellite magnitude (brightness), movement and viewing distance could be controlled. We wanted to use the video time compression equipment in our laboratory to determine the best combination of parameters, prior to using it on real satellite imagery. However, once the Avionics Laboratory witnessed the dramatic improvement in detection time and ease of use, they insisted on taking the rack-mounted hardware to their Lincoln Labs test site at White Sands, New Mexico. After our brief indoctrination of the workings of the system with real satellite imagery, the Avionics Lab and Lincoln Lab personnel were so enamored by the capability they saw, they refused to release the device for our further testing. They used it to hone the time-compression parameters in a computerized version of the device, which is still in use today in GEODSS sites such as that on Maui, Hawaii.

— Wayne L. Martin, Chief
Visual Display Systems Branch
Human Engineering Division

Task, H. L., & Griffin, L. L. (1982). Electroluminescent lighting and other techniques for improving night vision goggles compatibility with cockpit displays. *AGARD Conference Proceedings No. 329.* Blackpool, UK. (NTIS No. AGARD-CP-329)

Task, H. L., & Griffin, L. L. (1982). PAVE LOW III: Interior lighting reconfiguration for night lighting and night vision goggle compatibility. *Aviation, Space, and Environmental Medicine, 53*, 1162-1165.

Task, H. L., Kocian, D. F., & Brindle, J. H. (1980). Helmet mounted displays: Design considerations. *AGARDograph 255: Advancement on Visualization Techniques* (pp. 10-1 - 10-13). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-AG-255)

Task, H. L., Mallory, W. R., Griffin, L. L., & Defrances, A. J. (1981). Incandescent versus electroluminescent lights for austere runway lighting. *1981 AFSC/NAVMAT Science and Engineering Symposium* (pp. 249-270). Wright-Patterson AFB, OH: Air Force Systems Command.

Task, H. L., Pinkus, A. R., & Hornseth, J. P. (1978). A comparison of several television display image quality measures. *Society for Information Display International Symposium: Digest of Technical Papers, 9*, 32-33.

Task, H. L., & Verona, R. W. (1976). *A new television display quality measure relatable to observer performance* (AMRL Technical Report 76-73). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A030 568)

Task, H. L., Verona, R. W., & Brindle, J. H. (1975). Sine wave response analysis and its interpretation for determining television display quality. *Optical Society of America Symposium.*

Taylor, D. F., Snyder, M. S., & Snyder, H. L. (1976). *Computerized analysis of eye movements during static display visual search* (AMRL Technical Report 75-91). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A024 100)

Tebbetts, I., McConville, J. T., & Alexander, M. (1979). *Height/weight sizing programs for women's protective garments* (AMRL Technical Report 79-35). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A072 376)

Topmiller, D. A. (1976). Man-machine command-control-communication simulation studies in the Air Force. In R. M. Thrall, C. P. Tsokos, & J. C. Turner *Proceedings of AFOSR Workshop on Decision Information for Tactical Command and Control* (AMRL Technical Report 76-122). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 042 148)

Topmiller, D. A. (1978). Simulation. *Encyclopedia of neurology psychiatry and psychology.*

Topmiller, D. A. (1981). Methods, past approaches, current trends and future requirements. In Moral, & Kraiss (Eds.), *Manned systems design.* New York: Plenum Press.

Topmiller, D. A., & Aume, N. M. (1977). *Computer-graphic design for human performance* (AMRL Technical Report 77-74). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A055 132)

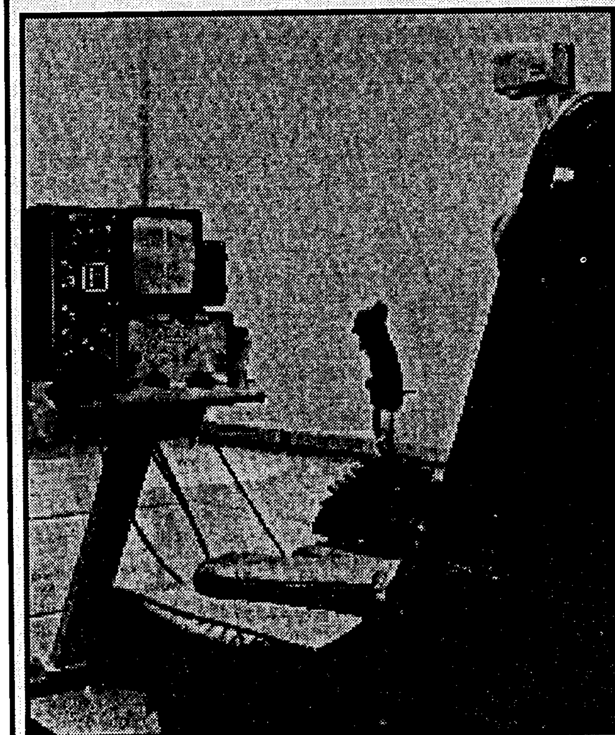
Tutin, M. B., Nelson, D., & Task, H. L. (1982). *Effects of windscreen halation on night visual performance* (AFAMRL-TR-82-47). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Verona, R. W., Task, H. L., Arnold, V. C., & Brindle, J. H. (1979). A direct measure of CRT image quality. *Proceedings of the Society of Photo-Optical Instrumentation Engineers (SPIE), 196.*

Verona, R. W., Task, H. L., Arnold, V. C., & Brindle, J. H. (1979). *A direct measure of CRT image quality* (USAARL Report No. 79-14). Ft. Rucker, AL: US Army Aeromedical Research Laboratory.

Vikmanis, M. M., & Kou, R. S. (1979). *Monte Carlo simulation of an AAA system using the observer model* (AMRL Technical Report 79-78). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A080 972)

Ward, F., Wilson, D., & Wallquist, D. (1984). *Development of color criteria for advanced displays* (AFAMRL Technical Report 84-23). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. 143 246)



WORKSTATION FOR A GUIDED BOMB SYSTEM

Operator's workstation of the weapon delivery simulator for the GBU-15 TV-guided bomb used to evaluate alternative video imagery processes in jammed and unjammed environments. Researchers were Robert G. Mills of AMRL, Franklin T. Hutson and Walter B. Hartman of the Air Force Wright Aeronautical Laboratories, and Edwin G. Meyer, Herbert Navarro, Constance M. Hoyland, and Robert R. Covelli of the System Development Corporation. AFAMRL-TR-81-45 (1981) (Project 6893)

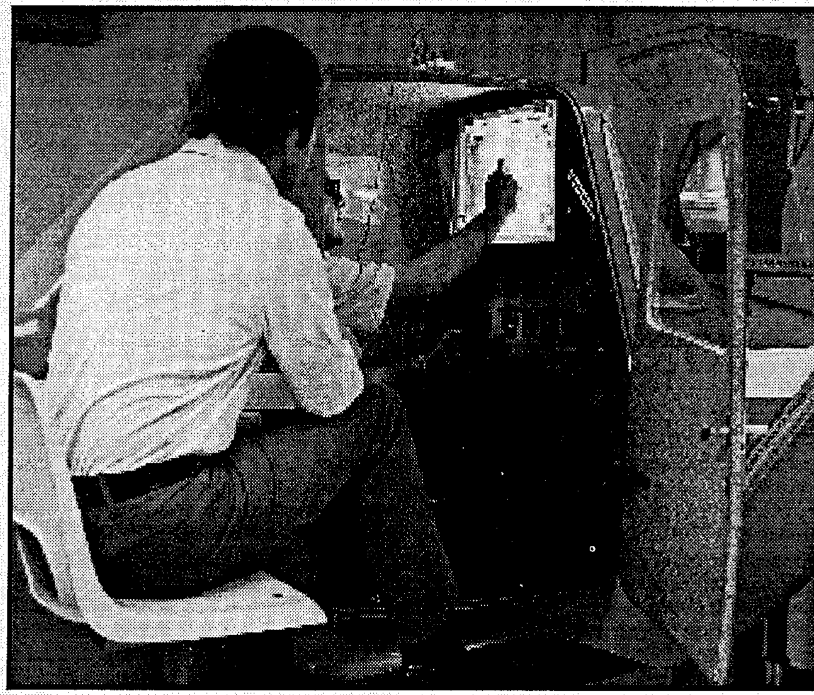
Ward, F., Wilson, D., Wallquist, D., & Kuperman, G. G. (1984). Color coding of synthetic aperture radar imagery. *Proceedings of the Human Factors Society 28th Annual Meeting, 1, 303-307.*

Ward, F. E., DeFrances, A. J., & Eggleston, R. G. (1979). *Development of a visual inspection technique (optical assessment of aircraft transparencies)* (AMRL Technical Report 79-67). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A079 369)

Ward, S. L., & Poturalski, R. (1983). *Maze-solving as a performance measurement tool for human operations under time-stress* (AFAMRL Technical Report 83-052). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A133 394)

Warren, R., Genco, L. V., & Connon, T. R. (1984). *Horizontal diplopia thresholds for head-up displays* (AFAMRL Technical Report 84-018). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A141 965)

Warren, R., & McMillan, G. R. (1983). Application of active psychophysics to an altitude regulation task. *Bulletin of the Psychonomic Society, 22*, 349-350.



A SUBJECT IN A WORKLOAD STUDY
Gary Reid observing a subject at a display in a study examining both physiological and psychological measures of workload in a simulation of a general aviation cross-country instrument flight. This work was done in 1982. (Task 718414)

Warren, R., & McMillan, G. R. (1984). Altitude control using action-demanding interactive displays: Toward an active psychophysics. *Proceedings of the 1984 Image III Conference* (pp. 37-51). Williams AFB, AZ: Air Force Human Resources Laboratory.

Warren, R., & McMillan, G. R. (1984). Individual differences in altitude holding. *Aviation, Space, and Environmental Medicine, 55*, 461.

Wartluft, D. L. (1975). *Program documentation for the RPV-auto simulation program* (AMRL Technical Report 75-21). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A013 847)

Wartluft, D. L. (1976). *Program documentation for the RPV mission control center system simulation program* (AMRL Technical Report 76-47). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A028 879)

Wei, K. C. (1981). *A human operator gunner model for tracer-directed antiaircraft artillery fire* (AFAMRL Technical Report 80-142). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A097 824)

Williams, J. I. (1984). *Human response to pyridostigmine bromide* (AFAMRL Technical Report 84-004). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A140 960)

Wilson, G. F., & O'Donnell, R. D. (1981). *Human sensitivity to high frequency sine wave and pulsed light stimulation as measured by the steady state cortical evoked response* (AMRL Technical Report 80-133). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A097 730)

Wilson, G. F., O'Donnell, R. D., & Wilson, L. (1983). *Neuropsychological measures of A-10 workload simulated low altitude missions* (AFAMRL Technical Report 83-0003). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Lab-oratory. (DTIC No. A128 184)

Wilson, G. F., Ward, S. L., & Hann, R. L. (1983). Use of the transient evoked response in a crucial event task. *USAF Medical Service Digest*, 20-22.

Wortman, D. B., & Duket, S. D. (1976). *New developments in SAINT: The Saint III Simulation Program* (AMRL Technical Report 75-117). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A029 894)

Wortman, D. B., & Duket, S. D. (1976). *SAINT simulation of a remotely piloted vehicle/drone control facility: Model development and analysis* (AMRL Technical Report 75-118). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A031 085)

Wortman, D. B., Duket, S. D., & Seifert, D. J. (1976). *SAINT simulation of a remotely piloted vehicle/drone control facility* (AMRL Technical Report 75-68). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A027 812)

Wortman, D. B., Duket, S. D., Seifert, D. J., Hann, R. L., & Chubb, G. P. (1978). *The SAINT User's Manual* (AMRL Technical Report 77-62). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A058 724)

Wortman, D. B., Duket, S. D., Seifert, D. J., Hann, R. L., & Chubb, G. P. (1978). *Simulation using SAINT: A user-oriented instruction manual* (AMRL Technical Report 77-61). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A058 671)

Wortman, D. B., Sigal, C. W., Pritsker, A. A. B., & Seifert, D. J. (1975). *New SAINT concepts and the SAINT II Simulation Program* (AMRL Technical Report 74-119). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A014 814)

"In 1969 I found myself working in the lab with a new boss, Dick Ravanell, an Air Force major. He was a fighter pilot and knew the ins-and-outs of high speed maneuvering and its effects on the pilot. I had worked with zero-G environments and was aware of the potential effects on human performance under different G forces. We began to anticipate the potential impact on the pilot of the new, higher G loads that the next generation of fighter aircraft were going to be able to withstand."

— Phil Kulwicki, Technical Director
Crew-Centered Cockpit Design
Human Engineering Division

"My most enjoyable project was working on the pre-cursor of the Manned Orbiting Laboratory (MOL). When NASA was set up, that research was turned over to them, but until then the Air Force had a program in the area. I worked on it intermittently for two or three years as the Human Engineering focal point on the MOL team. One of the things we investigated was whether humans could operate outside of a spacecraft to make repairs—what was later called the "space walk"— and to determine what kind of tools they would need. This was a very fundamental question in those days. The lab had access to C-131 and C-135 zero-G aircraft, and many people were involved in studying what kind of tools would be required — such as torque-canceling socket wrenches — to work in that kind of environment."

— Steve Heckart
Applications Human Engineer
Human Engineering Division

Wortman, D. B., Sigal, C. W., Pritsker, A. A. B., & Seifert, D. J. (1975). *SAINT II Documentation Manual* (AMRL Technical Report 75-116). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A024 286)

Yates, R., Replogle, C., & Veghte, J. (1980). *Thermal and acceleration effects on aircrew members in chemical defense gear* (AMRL Technical Report 79-71). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A086 026)

Young, J. W., Chandler, R. F., Snow, C. C., Robinette, K. M., Zehner, G. F., & Lofberg, M. S. (1983). *Anthropometric and mass distribution characteristics of the adult female* (FAA-AM-83-16). Washington, DC: Federal Aviation Administration.

Yu, C. (1981). *A human operator gunner model for a tracking task with interrupted observations in an antiaircraft artillery system* (AFAMRL Technical Report 81-37). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A097 360)

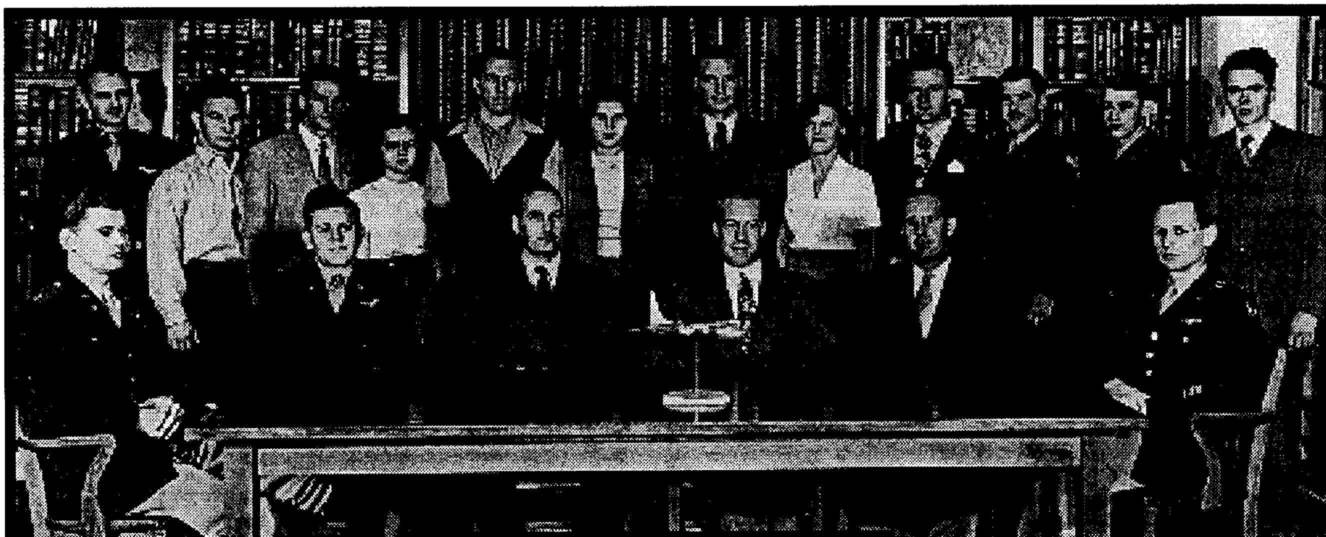
Zacharias, G. L. (1978). *Motion cue models for pilot-vehicle analysis* (Report No. AMRL-TR-78-2). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory.

Zacharias, G. L., & Levison, W. H. (1979). *A performance analyzer for identifying changes in human operator tracking strategies* (AMRL Technical Report 79-17). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. A070 632)

Zehner, G. F. (1984). Analytical relationships between body dimensions and mass distribution characteristics of living populations. In A. Mital (Ed.), *Trends in Ergonomics/Human Factors I* Amsterdam: Elsevier.

The VCASS (Visually-Coupled Airborne Systems Simulator) helmet is an example of an incredible design option. The helmet's miniaturized electronics project an image onto a screen approximately two inches in front of the pilot's eyes and offer a view of what is outside the cockpit. Flight data are superimposed over the scene. Using that information, the pilot activates aircraft systems with eye and hand movements and also voice commands. This replaces the pushing of knobs and buttons which are nearly eliminated from the cockpit.

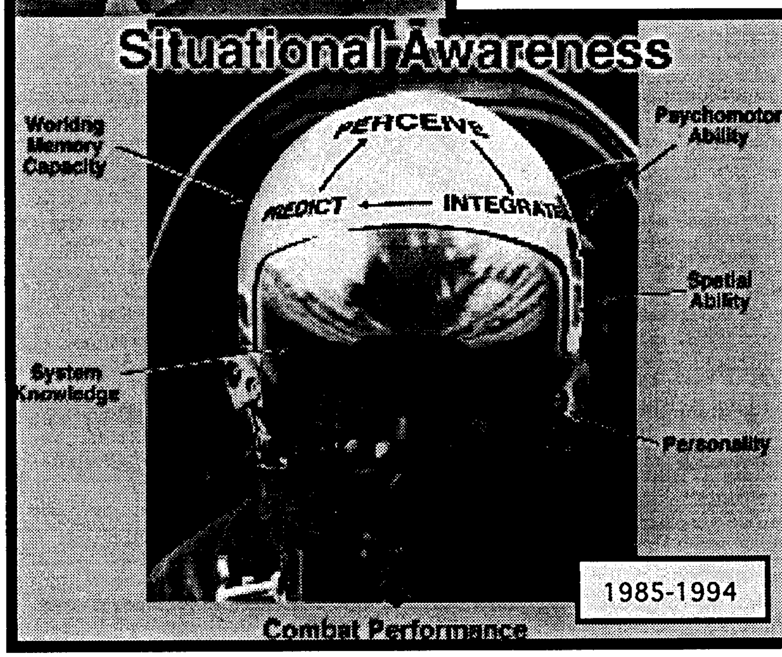
—May 1985, "Human Engineering, Yesterday and Today,"
Civilian Employees Reporter



The End of the Cold War

1985-1994

The military build-up of the Reagan years will prove too much for a bankrupt Soviet Union which splinters, surrendering its super-power status. The Air Force responds by concentrating efforts on "global reach, global power." Air Force laboratories are subject to the inevitable post-Cold War drawdown, and research programs are recast to emphasize dual-use and commercialization potential. The user-oriented Bates years at the Human Engineering Division continue until his retirement in 1991 when he is replaced by Dr. Kenneth R. Boff.



Aaranson, J., Hassoun, J., Sharits, T., & Sharp, E. (1986). *Unknown signals on the B-1B's threat situation format display of the AN/ALQ-161 electronic warfare system—Will color coding help?* (Report No. AAMRL-TR-86-048). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B108346)

Abrams, T. S., Martin, C. D., Orr, C. E., & Hinson, T. A. (1991). *Cockpit automation technology CSERIAC-CAT Jul 89 - Dec 90: Final report* (Report No. AL-TR-1991-0078). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A273124)

Acton, W., Perez, W., & Reid, G. B. (1986). On the dimensionality of subjective workload. *Proceedings of the Human Factors Society 30th Annual Meeting, 1*, 76-80.

Albery, W. B., Repperger, D. W., Reid, G. B., Goodyear, C., Ramirez, L. E., & Roe, M. M. (1987). Effects of noise on a dual task: Subjective and objective workload correlates. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON)*.

Allen, D., Tsou, B., Gieske, G., Bien, J., Shipley, M., & Walker, J. L. (1987). System performance of a servo-optical projection system (SOPS). *The 1987 IMAGE Conference IV* (pp. 121-127). Williams AFB, AZ: Air Force Human Resources Laboratory.

Amell, J., Eggemeier, F. T., & Acton, W. (1987). The Criterion Task Set: An updated battery. *Proceedings of the Human Factors Society 31st Annual Meeting, 1*, 405-409.

Anderson, A. F., Amell, J. R., Boyd, S. P., Edwards, R. E., Hanson, D. C., Koehn, M. S., Kraushar, P. G., Leininger, W. E., McCon-nell, J. N., Ostrand, R. A., Pippin, C. C., Stollings, M. N., Wallace, M. R., White, R. W., & Zaitzeff, L. P. (1994). *Cockpit automation technology final report volume I: Summary of technical effort* (Report No. AL/CF-Technical Report-1994-0004). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B182787)

Anderson, A. F., Crouch, D. A., Edwards, R. E., Kraushar, P. G., Leininger, W. E., McConnell, J. N., Ostrand, R. A., Stollings, M. N., & White, R. W. (1991). *Cockpit automation technology interim technical report 8* (Report No. AL-TR-1991-0100). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B161113)

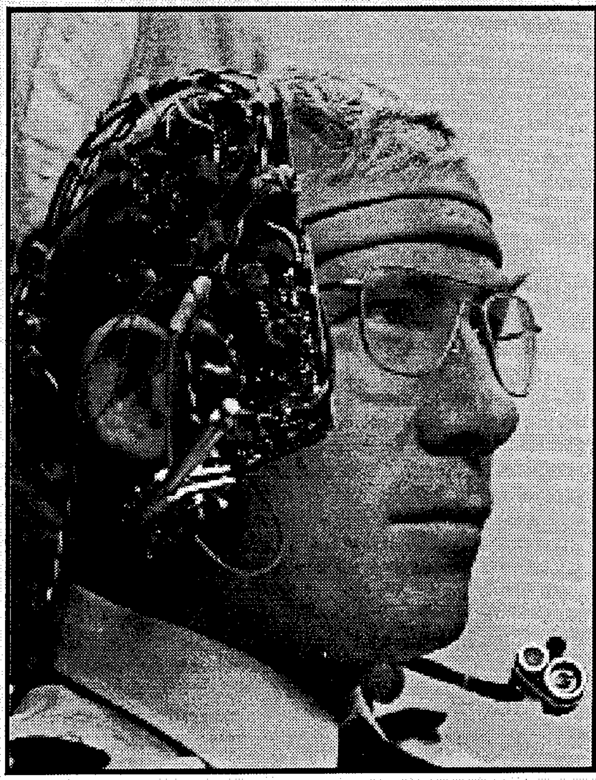
Andes, R. C., & Hunt, R. M. (1990). *Adaptive aiding for human-computer control: Final report and future directions for research* (Report No. AAMRL-TR-90-055). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A236799)

Andes, R. C., Hunt, R. M., Andriole, S. J., & Adelman, L. (1989). *Cognitive engineering of advanced information technology for Air Force systems design & development* (Report No. AAMRL-TR-89-038). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A218558)

Andrews, R., Baltzer, R., Boone, A., Garcia, L., Gier, R., Givens, B., Jackson, K., Korna, M., Lehman, E., Martin, C., Rolek, E., Rountree, M., Runnder, K., Sharp, R., Stadler, J., Storey, B., & Sweaney, M. (1994). *Interim technical report no. 1 (ITRI)* (Report No. AL/CF-TR-1994-0077). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A286426)

A LAB SCIENTIST AT THE SABER STATION

Gilbert G. Kuperman working at a repeater station of the Strategic Avionics Battle management Evaluation and Research (SABER) facility which supports in-house exploratory development in sensor-mediated target acquisition. The work at SABER aids the design and integration of advanced avionics capabilities including integrated multi-sensors, automatic target cuers and recognizers, precision strike, and mission planning. (1989) (Workunit 71841044)



REFRACTIVE ERROR IN DIOPTERS
Effect of attendance at USAF Academy on eye refractive error of aviation cadets. The study was done by Maj Melvin R. O'Neal and Capt Thomas R. Connon under Workunit 71841803. AAMRL-TR-86-026 (1986)

Annis, J. F., McDaniel, J. W., & Krauskopf, P. J. (1991). Male and female strength for performing common industrial tasks in different postures. In W. Karwowski, & J. W. Yates (Eds.), *Advances in Industrial Ergonomics and Safety III* (pp. 193-200). London: Taylor & Francis.

Arbak, C., King, P., Jauer, R., & Adam, E. (1988). *Helmet-mounted display/sight tactical utility study* (Report No. AAMRL-TR-88-022). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A240170)

Arndt, C. M. (1991). *Development of the expert system domain advisor and analysis tool* (Report No. AL-TR-1991-0150). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A255768)

Arndt, C. M. (1992). Applications for neural networks to landmark detection in three-dimensional surface data. *Proceedings of the Society of Photo-Optical Instrumentation Engineers (SPIE)*, 880-886.

Aume, N. M. (1989). CREW CHIEF: A computer graphics simulation of an aircraft maintenance technician. In S. Griffin (Ed.), *Third Annual Workshop on Space Operations, Automation, and Robotics (SOAR '89)* (NASA CP-3059, pp. 139-141). Washington, DC: National Aeronautics and Space Administration.

Ayoub, M. M., Jiang, B. C., Smith, J. L., Selan, J. L., & McDaniel, J. W. (1987). Establishing a physical criterion for assigning personnel to U.S. Air Force jobs. *American Industrial Hygiene Association Journal, 48*(5), 464-470.

Ayoub, M. M., Smith, J. L., McDaniel, J. W., & Selan, J. L. (1985). Job demands in some maintenance operations. In I. D. Brown, R. Goldsmith, K. Coombes, & M. A. Sinclair (Eds.), *Proceedings of the 9th Congress of the International Ergonomics Association*, 445-447.

Badeau, A. (1991). Task difficulty assessed using the correlation dimension of EEG [Poster]. In D. W. Duke, & W. S. Pritchard (Eds.), *EEG/Chaos Conference/Workshop* (pp. 60-63). River Edge, NJ: World Scientific.

Ballman, J. (1985). *A study of error rates in voice recognition* (AFAMRL Technical Paper 85-300). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Barbato, M. H., Hausmann, M. A., Kama, W. N., Bridenbaugh, J. C., & Task, H. L. (1993). *Definitions of terms relating to aircraft windscreens, canopies, and transparencies* (Report No. AL-TR-1993-0036). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A268403)

Barrett, E. S., & Wilson, G. F. (1987). *Topographic mapping of brain activity* (Report No. AAMRL-TR-87-069). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A204056)

Bart, R. D., Dembeck, C. M., & Masak, J. R. (1987). *SCPS-M processing study — phase II* (Report No. AAMRL-TR-87-057). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B118552)

Bartell, R. J., Unger, S. E., & Task, H. L. (1993). *Backscatter haze device for measurement of haze in aircraft transparencies* (Report No. AL/CF-TR-1993-0102). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A275127)

Beaton, R. J., & Farley, W. W. (1992). *Comparative study of the MTFA, ICS, and SQRI image quality metrics for visual display systems* (Report No. AL-TR-1992-0001). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A252116)

Beaton, R. J., & Farley, W. W. (1994). *Image quality metrics for color CRT displays* (Report No. AL/CF-TR-1994-0115). Wright-Patterson AFB, OH: Armstrong Laboratory.

Beaudet, D. B., Price, D. L., Kuperman, G. G., & Wilson, D. L. (1987). *Human factors report on information management requirements for next-generation manned bombers* (Report No. AAMRL-TR-87-042). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A195870)

Beecher, R. M. (1986). Computer graphics and shape diagnostics. *Proceedings of the Human Factors Society 30th Annual Meeting, 1*, 211-215.

Beecroft, S. L., Perez, W. A., Kirtland, W. H., & Taylor, T. G. (1988). *Strategic mission decomposition: III. Mission planning requirements and scenario implementation for advanced conceptual bomber simulation studies* (Report No. AAMRL-TR-88-072). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. C956971)

Beer, J. (1992). Mental models midst the optical flow [Abstract]. *Proceedings of the 33rd Annual Meeting of the Psychonomics Society*, 335.

Beer, J. (1993). Perceiving scene layout through an aperture during visually simulated self-motion. *Journal of Experimental Psychology: Human Perception and Performance, 19*(1), 1-16.

Benedict, C. P., & Gunderman, R. G. (1992). Helmet-mounted systems test and evaluation process. *Proceedings of the Society of Photo-Optical Instrumentation Engineers (SPIE): Helmet-Mounted Displays III, 1695*, 8-12.

Berkstresser, G. W., Shmulovich, J., & Wittenberg, A. M. (1987). *Single crystal phosphor development* (Report No. AAMRL-TR-87-041). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B122929)

Bhatia, G. (1994). *Whole body surface scanner for design of protective equipment* (Report No. AL/CF-TR-1994-0034). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B186313)

Bhatia, G. H., Smith, K. E., Commean, P. K., Whitestone, J., & Vannier, M. W. (1994). Design of a multi-sensor optical surface scanner. *Photonics East '94, SPIE, Sensor Fusion VII, 2355*, 262-273.

Bhatia, G. H., Smith, K. E., Commean, P. K., Whitestone, J. J., & Vannier, M. W. (in press). Design and simulation of a whole body surface scanner. *Optics and Lasers in Engineering.*

Biberman, L. M., & Tsou, B. H. (1993). Image display technology and problems with emphasis on airborne systems. In W. D. Rogatto (Ed.), *The infrared and electro-optics systems handbook: Vol. 3. Electro-optical components* (pp. 437-506). Bellingham, WA: SPIE Optical Engineering Press.

Billman, E. R. (1987). *The role of adaptive supplemental visual cuing in flight simulation* (Report No. AAMRL-TR-87-070). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A185932)

Billman, E. R. (1989). Interactive, real-time formation flight concept trainer. In R. S. Jensen (Ed.), *Proceedings of the Fifth International Symposium on Aviation Psychology, 2*, 209-214.

Blackwell, S. U., & Robinette, K. M. (1993). *Human integration evaluation of three helmet systems* (Report No. AL-TR-1993-0028). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A271320)

Blue, D. V., Flanagan, D. P., Giacaglia, R. A., Lenorovitz, D. R., & Stanke, E. C. (1987). *Rapid Intelligent Prototyping Laboratory (RIPL) architecture and use* (Report No. AAMRL-TR-87-004). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

Boer, L., Farmer, E., & Wilson, G. F. (1988). Standardized tests for research with environmental stressors: The AGARD Stress Battery. *AGARD Conference Proceedings 458: Human Behavior in High Stress Situations in Aerospace Operations* (pp. 23-1 - 23-16). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-CP-458)

Boff, K. R. (1986). Factoring ergonomics data into system design. *23rd Meeting of ASCC Working Party 10: Aircraft Information Display and Aircrew Design.*

Boff, K. R. (1987). Designing for design effectiveness of complex avionics systems. *AGARD Conference Proceedings 417: The Design, Development, and Testing of Complex Avionics Systems* (pp. 22-1 - 22-9). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-CP-417)

Boff, K. R. (1987). Matching crew system specifications to human performance capabilities. *AGARD Conference Proceedings 425: The Man-Machine Interface in Tactical Aircraft Design and Combat Automation* (pp. 29-1 - 29-9). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-CP-425)

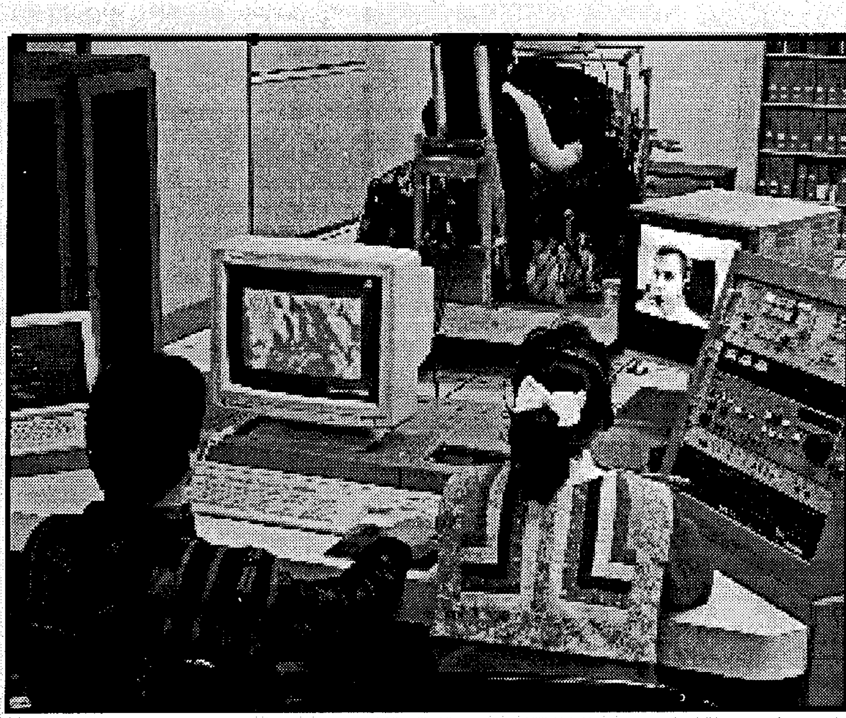
Boff, K. R. (1987). The Tower of Babel revisited: Cross-disciplinary chokepoints in system design. In W. B. Rouse & K. R. Boff (Eds.), *System design: Behavioral perspectives on designers, tools, and organizations* (pp. 1-13). New York: North Holland.

Boff, K. R. (1988). The value of research is in the eye of the beholder. *Human Factors Society Bulletin, 31*(6), 1-4.

Boff, K. R. (1990). Integrating ergonomics into system design. *CSERIAC Gateway, 1*(2), 1-2.

Boff, K. R. (1990). Meeting the challenge: Factors in the design & acquisition of human-engineered systems. In H. Booher (Ed.), *MANPRINT: An approach to systems integration* (pp. 551-572). New York: Von Nostrand Reinhold.

Boff, K. R. (1993). Advances in human prototyping: Implications for crew system integration and system safety. *Proceedings of the International Conference on Aircraft Flight Safety.* Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development.



CREW-CENTERED ANALYSIS AND DESIGN SUPPORT

The Crew-Centered Analysis and Design Support Laboratory is the focal point for demonstrating advanced concepts in crewstation design and evaluation technology for the Crew-Centered Cockpit Design (CCCD) project. The rapidly reconfigurable Engineering Design Simulator (EDSIM), as seen here, is used for rapid prototyping and design evaluation. Using the EDSIM, under part-task/full-mission scenarios, various data are collected to verify and validate crewstation designs including mission events and human performance measures (aircrew actions, audio, visual, and physiological responses). (Workunit 28290309)

Boff, K. R. (1994). The usability of behavioral research findings in system design. In Gartner, Widdel, & Ste (Eds.), *Mensch-Maschine-Systeme und Neue Informationstechnologien.* Dusseldorf: Carl Hansa Verlag Mur and VDI Verlag.

Boff, K. R., Kaufman, L., & Thomas, J. (1986). *Handbook of perception and human performance: Cognition and performance.* New York, NY: John Wiley & Sons.

Boff, K. R., Kaufman, L., & Thomas, J. (1986). *Handbook of perception and human performance: Sensation and perception.* New York, NY: John Wiley & Sons.

Boff, K. R., & Lincoln, J. E. (Eds.). (1988). *Engineering data compendium: Human perception and performance* (Vol. 1-3). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

Boff, K. R., & Lincoln, J. E. (Eds.). (1989). *Engineering data compendium: Human perception and performance (Compact Disk ed.).* Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

Boff, K. R., & Martin, E. A. (1988). Human performance data in simulation design. *AIAA Flight Simulation Technologies Conference,* 1-5.

Boff, K. R., & Monk, D. L. (1992). Computer-aided systems human engineering: A hypermedia tool. *CSERIAC Gateway, 3*(2), 1-5.

Boff, K. R., Monk, D. L., Swierenga, S. J., Brown, C. E., & Cody, W. J. (1991). Computer-aided human factors for systems designers. *Proceedings of the Human Factors Society 35th Annual Meeting, 1,* 332-336.

Boff, K. R., Polzella, D. J., & Morton, K. (1990). Crew system ergonomics information analysis center: A gateway for technology transfer. In R. W. Harrison (Ed.), *Proceedings of the Technology Transfer Society 15th Annual Meeting, International Symposium and Exhibit: Technology Transfer in a Global Economy,* 277-282.

Bondurant, R., Coonrod, J., Kuperman, G., Moss, R., Graham, D., Hughes, R., & Kraska, A. (1986). *F-16E crew system assessment working group, Volume I, executive summary* (Report No. AFWAL-TR-85-3111). Wright-Patterson AFB, OH: Air Force Wright Aeronautical Laboratories.

Dr. Fitts is the premier leader in the analysis and solution of World War II crew station design issues which, in turn, led to the founding of human engineering technology. We are indeed honored to be able to honor him by naming a modern human engineering research facility in his name.

— Col George C. Mohr, AFAMRL Commander, May 1985, "Pioneer in Human Engineering is Due the Ultimate Honor," Civilian Employees Reporter

Borah, J. (1989). *Helmet-mounted eye tracking for virtual panoramic displays Volume I: Review of current eye movement measurement technology* (Report No. AAMRL-TR-89-019). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A273101)

Borah, J. (1989). *Helmet-mounted eye tracking for virtual panoramic displays Volume II: Eye tracker specification and design approach* (Report No. AAMRL-TR-89-019). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A273101)

Bortolussi, M. R., & Vidulich, M. A. (1989). The benefits and costs of automation in advanced helicopters: An empirical study. In R. S. Jensen (Ed.), *Proceedings of the Fifth International Symposium on Aviation Psychology, 2,* 594-599.

Bortolussi, M. R., & Vidulich, M. A. (1991). The effects of speech controls on performance in advanced helicopters in a double stimulation paradigm. *Proceedings of the Sixth International Symposium on Aviation Psychology, 1,* 216-221.

Bortolussi, M. R., & Vidulich, M. A. (1991). An evaluation of strategic behaviors in a high-fidelity simulated flight task: Comparing primary performance to a figure of merit. *Proceedings of the Sixth International Symposium on Aviation Psychology, 2,* 1101-1106.

Bradtmiller, B., Blackwell, S., Case, H., Churchill, T., Mountjoy, D., Gross, M., Kennedy, K., Pollack, R., Robinson, J., Seely, C., & Wysong, M. (1994). *Human morphometrics, motion, and performance research* (Report No. AL/CF-TR-1994-0038). Wright-Patterson AFB, OH: Armstrong Laboratory.

Brainard, L. F., Johnson, M. N., Perez, W. A., Taylor, T. G., & Kuperman, G. G. (1987). *Strategic mission decomposition: II. Artificial intelligence frame-based workload analysis study* (Report No. AAMRL-TR-87-077). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B119938)

Brett, B., Daugherty, E., Waltensperger, M., & Arndt, C. (1994). *Minuteman III Weapon Systems Safety Assessment (WSSA) human factor analysis* (Report No. AI/CF-TR-1994-0125). Wright-Patterson AFB, OH: Armstrong Laboratory.

Brown, C. E., Boff, K. R., & Swierenga, S. J. (1991). Cockpit resource management: A social psychological perspective. *Proceedings of the Sixth International Symposium on Aviation Psychology, 1*, 398-403.

Brown, C. E., Jennings, L. S., & Ward, S. L. (1984). *Team problem solving: Leader proficiency, communication, and coworker's functions* (Report No. AFAMRL-TR-84-056). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Brown, C. E., & Leupp, D. G. (1985). *Team performance with large and small screen displays* (Report No. AFAMRL-TR-85-033). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. 158 761)

Brown, C. E., Selvaraj, J. A., Zaff, B. S., McNeese, M. D., & Whitaker, R. D. (1994). An integrative bargaining paradigm for investigating multidisciplinary design tradeoffs. *Proceedings of the Human Factors and Ergonomics Society 38th Annual Meeting, 2*, 1028-1032.

Brown, C. E., Swierenga, S. J., & Wellens, A. R. (1991). Social psychological metaphors for human-computer systems design. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON)*, 793-799.

Brown, R. (1986). *Aircraft Ground Flotation System (AGFS) test, evaluation, and analysis for an F-16* (Report No. AFWAL-TR-86-3024). Wright-Patterson AFB, OH: Air Force Wright Aeronautical Laboratories.

Brown, R. W. (1987). Preliminary design of an air cushion crash rescue vehicle. *Proceedings of Air Cushion Technology Conference*, 56-62.

Brown, R. W., & Thom, R. (1986). *Preliminary design of an Air Cushion Crash Rescue Vehicle (ACCRV)* (Report No. AIAA-86-2377). Washington, DC: American Institute of Aeronautics and Astronautics.

Brown, Y. J., Cardullo, F. M., & McMillan, G. R. (1990). Advanced techniques for cuing the force and motion environment in the simulator of the future. *AIAA Flight Simulation Technologies Conference*, 115-122.

Brown, Y. J., Cardullo, F. M., McMillan, G. R., Riccio, G. E., & Sinacori, J. B. (1992). *New approaches to motion cuing in flight simulators* (Report No. AL-TR-1991-0139). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A277571)

Buchroeder, R. A., & Kocian, D. F. (1989). *Display system analysis for the LHX helicopter application* (Report No. AAMRL-TR-89-001). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B134738)

Bui, T. H., Vollmerhausen, R. H., & Tsou, B. H. (1994). Overlap binocular field-of-view flight experiment. *Society for Information Display International Symposium: Digest of Technical Papers, 25*, 306-308.

Busch, C., Wilson, G. F., Orr, C., & Papanicolaou, A. (1989). Crossmodal interactions of auditory stimulus presentation on the visual evoked magnetic response. In S. J. Williamson, M. Hoke, G. Stroink, & M. Kotani (Eds.), *Advances in biomagnetism: Proceedings of the 7th International Conference on Biomagnetism* (pp. 221-224). New York: Plenum.

Busch, C., Wilson, G. F., & Ullsperger, P. (1993). Influence of task difficulty and expectedness on the P300 elicited by a warning stimulus [Abstract]. *Society for Neuroscience: Abstracts, 19*(2), 1606.

Caldwell, J. A., Wilson, G. F., Gaillard, A. W. K., Gundel, A., Lagarde, D., Makeig, S., Myhre, G., & Wright, N. A. (Eds.). (1994). *Psychophysiological assessment methods* (Report

No. AGARD-AR-324). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-AR-324)

Calhoun, C. S., & Post, D. L. (1990). Heterochromatic brightness matches via Ware & Cowan's luminance correction equation. *Society for Information Display International Symposium: Digest of Technical Papers, 21,* 261-264.

Calhoun, G. L. (1987). *Eye and head response to an attention cue in a dual task paradigm* (Report No. AAMRL-TR-87-033). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A191052)

Calhoun, G. L., Arbak, C. J., & Janson, W. P. (1985). Eye and head response to an attention cue in a dual task paradigm. *Proceedings of the Human Factors Society 29th Annual Meeting,* 1125-1129.

Calhoun, G. L., & Janson, W. P. (1990). Eye and head response as indicators of attention cue effectiveness. *Proceedings of the Human Factors Society 34th Annual Meeting, 1,* 1-5.

Calhoun, G. L., & Janson, W. P. (1991). Eye control interface considerations for aircrew station design [Abstract]. *Proceedings of the 6th European Conference on Eye Movements,* 85.

Calhoun, G. L., & Janson, W. P. (1991). *Eye line-of-sight control compared to manual selection of discrete switches* (Report No. AL-TR-1991-0015). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A273019)

Calhoun, G. L., & Janson, W. P. (1992). *Eye and head response as indicators of attention cue effectiveness* (Report No. AL-SR-1992-0022). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A275391)

Calhoun, G. L., Janson, W. P., & Arbak, C. J. (1986). Use of eye control to select switches. *Proceedings of the Human Factors Society 30th Annual Meeting, 1,* 154-158.

Calhoun, G. L., Janson, W. P., & Valencia, G. (1988). Effectiveness of three-dimensional auditory directional cues. *Proceedings of the Human Factors Society 32nd Annual Meeting, 1,* 68-72.

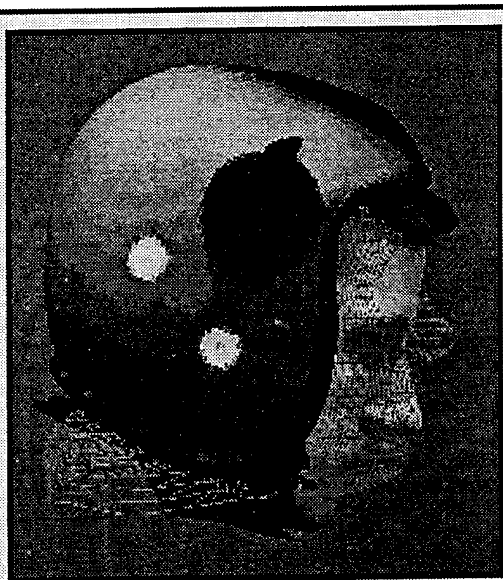
DEVELOPING TOOLS FOR COCKPIT DESIGN AND EVALUATION

Dr. Joe W. McDaniel working in the Crew-Centered Automated Design System Laboratory developing a suite of computer tools to assist in the design and evaluation of aircraft cockpits. The work is still in progress in 1994, although this picture was taken in 1993. (Project 2829)

Calhoun, G. L., Valencia, G., & Furness, T. A. (1987). Three-dimensional auditory cue simulation for crew station design/evaluation. *Proceedings of the Human Factors Society 31st Annual Meeting, 2,* 1398-1402.

Cannon, M. W. (1986). Recent advances in understanding peripheral vision. *Proceedings of the Human Factors Society 30th Annual Meeting, 1,* 601-604.

Cannon, M. W. (1989). Attention uncertainty accounts for the thresholds of multiple Gabor Patches. *Optical Society of America Annual Meeting Digest, 18,* 143.



FIT AS A SOURCE OF ANTHROPOMETRIC VARIATION

Three-dimensional geometric scans of two pilots, one a surface model and the other lines, aligned by the HGU 53/P helmets they wear. This illustrates the wide variation in the way equipment is worn, a variation which is often wider than the variation in the body size and shape of the population. (Workunit 71840846)

Cannon, M. W. (1990). Spatial pattern processing in human vision. *Society for Information Display International Symposium: Digest of Technical Papers, 21*, 452-455.

Cannon, M. W. (1992). A model for spatial interactions among contrast sensitive mechanisms. *Optical Society of America Annual Meeting Digest, 22*, 130.

Cannon, M. W. (1992). A model of mechanisms mediating spatial pattern perception. *Proceedings of the Human Factors Society 36th Annual Meeting, 2*, 1430-1434.

Cannon, M. W., & Fullenkamp, S. C. (1987). Probability summation among spatially separated patterns is less than predicted. *Investigative Ophthalmology and Visual Science, 28*, 357.

Cannon, M. W., & Fullenkamp, S. C. (1987). Spatial summation of non-contiguous stimuli [Abstract]. *Journal of the Optical Society of America, A4*, 124.

Cannon, M. W., & Fullenkamp, S. C. (1988). Multiple mechanism model for suprathreshold contrast perception [Abstract]. *Investigative Ophthalmology and Visual Science, 29*, 140.

Cannon, M. W., & Fullenkamp, S. C. (1988). Perceived contrast and stimulus size: Experiment and simulation. *Vision Research, 28*(6), 695-709.

Cannon, M. W., & Fullenkamp, S. C. (1989). A two dimensional model of contrast processing from threshold to high suprathreshold levels [Abstract]. *Investigative Ophthalmology and Visual Science, 30*, 504.

Cannon, M. W., & Fullenkamp, S. C. (1990). Inhibitory interactions in suprathreshold vision [Abstract]. *Investigative Ophthalmology and Visual Science, 31*, 323.

Cannon, M. W., & Fullenkamp, S. C. (1991). Lateral interactions among contrast sensitive mechanisms [Abstract]. *Optical Society of America Annual Meeting Digest, 17*, 164.

Cannon, M. W., & Fullenkamp, S. C. (1991). Spatial interactions in apparent contrast: Inhibitory effects among grating patterns of different spatial frequencies, spatial positions & orientations. *Vision Research, 31*(11), 1985-1998.

Cannon, M. W., & Fullenkamp, S. C. (1991). A transducer model for contrast perception. *Vision Research, 31*(6), 983-998.

Cannon, M. W., & Fullenkamp, S. C. (1992). A model for image sharpness estimates [Abstract]. *Investigative Ophthalmology and Visual Science, 33*, 1349.

Cannon, M. W., & Fullenkamp, S. C. (1993). Spatial interactions in apparent contrast: Individual differences in enhancement and suppression effects. *Vision Research, 33*(12), 1685-1695.

Cannon, M. W., & Fullenkamp, S. C. (1994). Target apparent contrast in the presence of peripheral flanking stimuli [Abstract]. *Investigative Ophthalmology and Visual Science, 34*(4), 2005.

Cardullo, F. M., Brown, Y. J., & McMillan, G. R. (1992). Analysis and development of advanced techniques for cuing the force and motion environment in the simulator of the future. *Proceedings of the European Forum on Matching Technology to Training Requirements*, 16-1 - 16-12.

Case, H., Ervin, C. A., & Robinette, K. M. (1989). *Anthropometry of a fit test sample used in evaluating the current and improved MCU-2/P masks* (Report No. AAMRL-TR-89-009). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A215173)

Chechile, R. A., Eggleston, R. G., Fleischman, R. N., & Sasseville, A. M. (1989). Modeling the cognitive complexity of displays. *Human Factors, 31*(1), 31-43.

Chelen, W., Kabrisky, M., Hatsell, C., Morales, R., Fix, E. L., & Scott, M. (1990). Use of phenytoin in the prevention of motion sickness. *Aviation, Space and Environmental Medicine, 61*, 1022-1025.

Chen, J. S., Tsou, B. H., & Grigsby, S. S. (1994). A study on contrast perception in noise. *Society for Information Display International Symposium: Digest of Technical Papers, 25*, 490-493.

Chevalier, J. R., Porter, C. D., & Replogle, C. R. (1986). *Chemical warfare scenarios for airbase challenge assessment* (Report No. AAMRL-TR-86-063). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. C954809)

Citera, M., McNeese, M., Brown, C., Selvaraj, J., Zaff, B., & Whitaker, R. (in press). Fitting information systems to collaborating design teams. *Journal of the American Society for Information Science.*

Citera, M., Selvaraj, J. A., Zaff, B. S., Brown, C. E., & McNeese, M. D. (1993). Development of a research paradigm to study collaboration in multidisciplinary design teams. In M. J. Smith, & G. Savendy (Eds.), *Abridged proceedings of the 5th International Conference on Human-Computer Interactions*, 174.

Coberly, V. J., & Wiederholt, B. J. (1989). Knowledge representation for simulation. *Proceedings of the 1989 Summer Computer Simulation Conference*, 596-601.

Cody, W. J. (1989). Designers as users: Design supports based on crew system design practices. *Proceedings of the American Helicopter Society 45th Annual Forum*, 423-435.

Cody, W. J., & Rouse, W. B. (1989). A test of criteria used to select human performance models. In G. R. McMillan (Ed.), *Applications of human performance models to system design* (pp. 511-531). New York: Plenum.

Cody, W. J., Rouse, W. B., & Boff, K. R. (1993). *Functional requirements for computer-based associates that support access and use of technical information* (Report No. AL/CF-TR-1993-0069). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A274603)

Cohen, J. B., Jackson, K., Kulwicki, P. V., Lehman, E. F., Martin, C., Rountree, M., & Storey, B. (1994). *Industry review of a crew-centered design process and toolset* (Report No. AL/CF-TR-1994-0063). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A282966)

Cona, T., & Monk, D. L. (1994). Improving the impact of human performance information on the process of human-system design. *Symposium on Human Interaction with Complex Systems*, 247-250.

Cona, T. R., & Monk, D. L. (1993). Bringing human performance data to the design table. *Proceedings of the Human Factors and Ergonomics Society 37th Annual Meeting, 2*, 1087-1095.

Cotton, C. T., Faklis, D., Bowen, J. P., & Morris, G. M. (1991). *Application of surface-relief diffractive optics in helmet-mounted displays* (Report No. AL-TR-1991-0089). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A278768)

Crabtree, M. S., & Davis, S. A. (1991). Criterion Task Set (CTS): Cognitive task battery development. *Proceedings of the Sixth International Symposium on Aviation Psychology*, 1154-1159.

Crabtree, M. S., Marcelo, R. A. Q., McCoy, A. L., & Vidulich, M. A. (1993). An examination of a subjective situational awareness measure during training on a tactical operations simulator. *Proceedings of the Seventh International Symposium on Aviation Psychology, 2*, 891-895.

Craig, J. L. (1986). Aircraft lighting considerations for formation flying. *Aircraft Attitude Awareness Workshop*, 32-39.

Craig, J. L. (1990). AAMRL night vision goggle technology. *HSD Night Vision Goggle Conference* (pp. 61-88). Brooks AFB, TX: Human Systems Division.

Craig, J. L. (1990). Crew interface technologies. *Field Program Managers Conference* (pp. 15-32). Brooks AFB, TX: Human Systems Division.

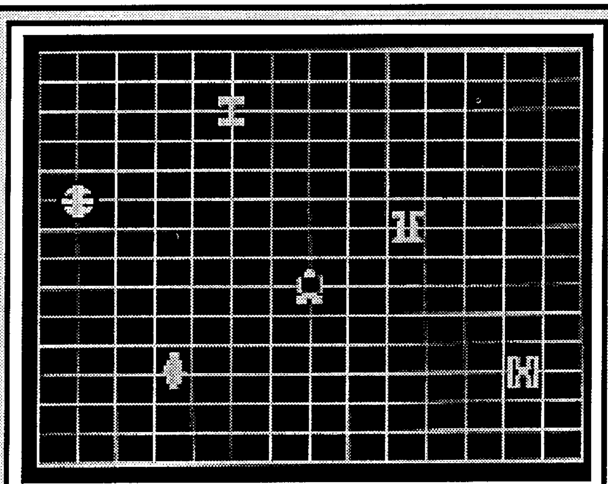
Craig, J. L. (1990). Helmet mounted programs. *Air Force Night Vision Device Working Group*, 72-94.

Craig, J. L. (1990). Status of NVG activity at AAMRL. *5th Annual Joint Service Night Vision Conference*, 47-65.

Craig, J. L. (1992). Laboratory night vision goggle efforts. *Air Force Special Operations Command Acquisition Program Conference* (pp. 514-529). Hurlbert Field, FL: Air Force Special Operations Command.

Craig, J. L., Anderson, M. L., & Simons, J. C. (1987). *Night Vision Goggle (NVG) compatible lighting for MH-53H (PAVE LOW III) special operations* (Report No. AAMRL-TR-87-058). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B119227)

Craig, J. L., Bartell, R. J., Hettinger, L. J., & Riegler, J. T. (1993). *Assessment of interior modifications in C-130 and C-141 aircraft for night vision goggle operations* (Report No. AL/CF-TR-1993-0095). Wright-Patterson AFB, OH: Armstrong Laboratory.



USING A DYNAMIC GRIDBOARD TO MEASURE SITUATIONAL AWARENESS

A grid board with moving symbols used in a study rating measures of situational awareness. The work was done by Maj Martin L. Fracker of the Human Engineering Division and Sharon A. Davis of Logicon Technical Services, Inc. AL-TR-1991-0091 (1991) (Task 718414)

Craig, J. L., & Purvis, B. D. (1987). Laboratory night vision goggle programs. *1st Strategic Air Command NVG Conference* (pp. 15-31). Offutt AFB, NE: Strategic Air Command.

Craig, J. L., & Purvis, B. D. (1990). B-52 night vision goggle head up display development. In H. M. Assenheim, & H. H. Bell (Eds.), *Proceedings of the Society of Photo-Optical Instrumentation Engineers (SPIE): Cockpit Displays and Visual Simulation, 1289*, 63-71.

Craig, J. L., Purvis, B. D., & Reynolds, M. C. (1988). *Night Vision Goggle (NVG) compatible cockpit lighting for B-52 special operations* (Report No. AAMRL-TR-88-028). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B127914)

Craig, J. L., Purvis, B. D., & Simons, J. C. (1988). *Formation lights for B-52 special operations: I. Design and test plan* (Report No. AAMRL-TR-88-051). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

Craig, J. L., Simons, J. C., & Unger, S. E. (1985). *Night vision goggle/head-up display for fixed-wing and rotary-wing special operations* (Report No. AAMRL-TR-85-044). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

Crawford, R. L., Toms, M. L., & Wilson, D. L. (1991). Effects of display luminance on the recognition of color symbols on similar color backgrounds. *Proceedings of the Human Factors Society 35th Annual Meeting, 2*, 1466-1470.

Cress, J. D., McMillan, G. R., & Gilkey, M. J. (1989). The dynamic seat as an angular cuing device: Control of roll & pitch vs the control of altitude & heading. *AIAA Flight Simulation Technologies Conference*, 94-100.

Cress, J. D., & Riccio, G. E. (1986). Frequency response of the visual system to simulated variations in altitude and its relationship to active control. *Proceedings of 22nd Annual Conference on Manual Control.*

Crystal, J. C., & Sigl, J. C. (1992). *Development of a portable G-hardened electrophysiological data input and storage device* (Report No. AL-SR-1992-0023). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B183999)

Curry, D. G. (1992). *Handedness and motor programming aspects of manual control and movement* (Report No. AL-TR-1992-0127). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A264022)

Davis, E. T., Corso, G. M., Barfield, W., Eggleston, R. G., Ellis, S., Ribarsky, B., & Wickens, C. D. (1994). Human perception and performance in 3D virtual environments. *Proceedings of the Human Factors and Ergonomics Society 38th Annual Meeting, 1,* 230-234.

DeLucia, P. R. (in press). Effects of pictorial relative size and ground-intercept information on judgments of object-object collisions in a perspective display: Implications for air-traffic control. *Human Factors.*

DeLucia, P. R. (1991). Object-motion, self-motion and object-motion during pictorial motion and motion-based information for depth perception. *Journal of Experimental Psychology: Human Perception and Performance, 17*(3), 738-748.

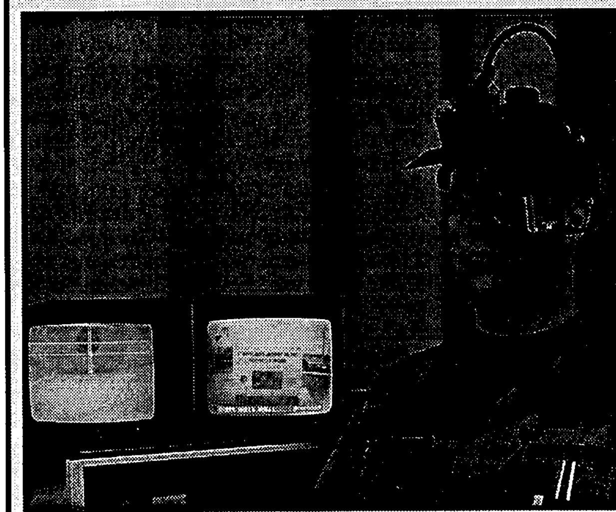
DeLucia, P. R., & Warren, R. (1994). Pictorial and motion-based depth information during active control of self-motion: Size-arrival effects on collision avoidance. *Journal of Experimental Psychology: Human Perception and Performance, 20,* 783-798.

Dembeck, C. M., & Masak, J. R. (1987). *SCPS-M processing study* (Report No. AAMRL-Technical Report-87-048). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B117565)

Dembeck, C. M., Porter, C. D., & James, G. M. (1987). *Baseline analysis of SCPS-2 operations* (Report No. AAMRL-TR-87-056). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B119349)

Dent, C., Klein, G., & Eggleston, R. G. (1987). *Metaphor casting of information—Display requirements* (Report No. KA-TR-868-87-01A). Yellow Springs, OH: Klein & Assoc.

Dent-Read, C. H., Klein, G., & Eggleston, R. G. (1994). Metaphor in visual display designed to guide action. *Metaphor and Symbolic Activity, 9*(3).



LINE-OF-SIGHT STUDIES

Lt Bryan Christensen is demonstrating a line-of-sight measuring system being used to study the direction of sight in helmet systems. This information is needed to optimize the design of helmet-mounted displays. (Workunit 71841158)

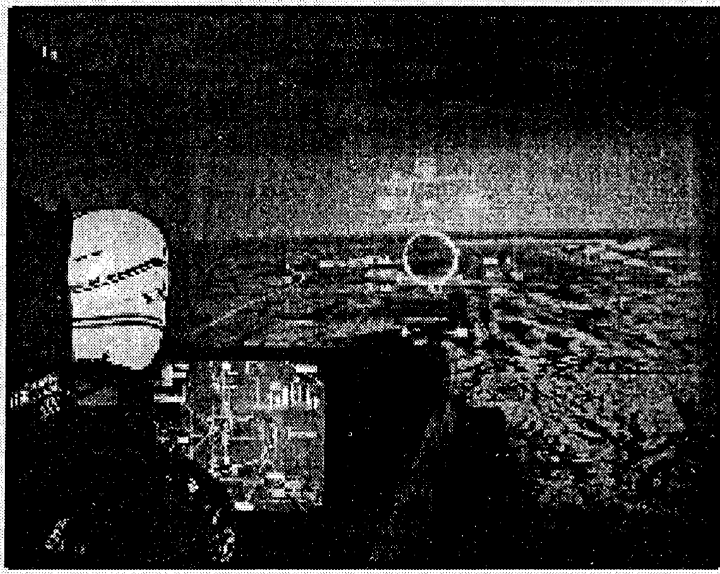
DeRego, P. (1989). Magnetoencephalographic data indicates separate component modeling is necessary in evaluating evoked responses. In S. Buus (Ed.), *Proceedings of the IEEE 15th Annual Northeast Bioengineering Conference,* 87-88.

DeRego, P. (1989). Magnetoencephalographic localization of simulated evoked response sources affirms the importance of adequate modelling. In S. J. Williamson, M. Hoke, G. Stroink, & M. Kotani (Eds.), *Advances in biomagnetism: Proceedings of the 7th International Conference on Biomagnetism,* 551-554.

Doll, T. J., Gerth, J. M., Engleman, W. R., & Folds, D. J. (1986). *Development of simulated directional audio for cockpit applications* (Report No. AAMRL-TR-86-014). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A175350)

Donohue-Perry, M. M. (1985). Color tolerances for night vision goggle compatible lighting. *Society of Automotive Engineers Interior Lighting Subcommittee Proceedings,* 10-21.

Donohue-Perry, M. M. (1985). A visual performance investigation of ANVIS field of view interference. *Society of Automotive Engineers Interior Lighting Subcommittee Proceedings,* 22-30.



A PROPOSED PANORAMIC COCKPIT FOR INCREASING SITUATIONAL AWARENESS

Panoramic cockpit control and display system (PCCADS 2000) developed in a program for increasing the situational awareness of pilots. This effort was jointly sponsored by AAMRL (AL/HEA) and the Wright Laboratory Cockpit Integration Directorate (WL/KTD). The work was done by John L. Olson, Christopher J. Arbak, and Richard A. Jauer of the McDonnell Douglas Corp. AL-TR-91-0017 (1991)

Donohue-Perry, M. M. (1992). *Changes in visual acuity after night vision goggle exposure* (Report No. AL-SR-1992-0031). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B178591)

Donohue-Perry, M. M., Hettinger, L. J., & Riegler, J. T. (1992). Human factors considerations for night vision system design: Preliminary results of NVG users' concerns survey. *7th Annual Joint Service Night Vision Device Conference,* 129-161.

Donohue-Perry, M. M., Hettinger, L. J., & Riegler, J. T. (1992). Human factors considerations for night vision system design: Preliminary results of NVG users' concerns survey [Abstract]. *Aerospace Medical Association 63rd Annual Scientific Meeting Program,* A6.

Donohue-Perry, M. M., Hettinger, L. J., & Riegler, J. T. (1992). *Night Vision Goggle (NVG) users' concerns survey site report: Hurlburt Field, FL* (Report No. AL-TR-1992-0089). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B171286)

Donohue-Perry, M. M., Hettinger, L. J., Riegler, J. T., & Davis, S. A. (1992). *Night Vision Goggle (NVG) users' concerns survey site report: Charleston AFB, SC* (Report No. AL-TR-1992-0177). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B173525)

Donohue-Perry, M. M., Hettinger, L. J., Riegler, J. T., & Davis, S. A. (1993). *Night Vision Goggle (NVG) users' concerns survey site report: Dover AFB, DE* (Report No. AL/CF-TR-1993-0075). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B178369)

Donohue-Perry, M. M., Hettinger, L. J., Riegler, J. T., & Davis, S. A. (1993). *Night Vision Goggle (NVG) users' concerns survey site report: Pope AFB, NC* (Report No. AL/CF-TR-1993-0071). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B274471)

Donohue-Perry, M. M., & Ramer, D. P. (1990). A visual performance assessment of ANVIS compatible lighting categories. *5th Annual Joint Service Night Vision Conference,* 89-102.

Donohue-Perry, M. M., & Ramer, D. P. (1990). A visual performance assessment of ANVIS compatible lighting categories. *Society for Information Display International Symposium: Digest of Technical Papers, 21,* 130-132.

Donohue-Perry, M. M., & Riegler, J. T. (1990). A compatibility evaluation of the protective integrated hood mask with ANVIS night vision goggles. *Report of the 30th Meeting of Air Standardization Coordination Committee (ASCC) Working Party 61: Aerospace Medical and Life Support Systems Symposium: Aero-medical Aspects of Vision* (Vol. 4, pp. 102-109). Toronto: Defence & Civil Institute of Environmental Medicine.

Donohue-Perry, M. M., & Riegler, J. T. (1991). An evaluation of the protective integrated hood mask for ANVIS night vision goggle compatibility. *AGARD Conference Proceedings 517: Helmet-Mounted Displays and Night Vision Goggles* (pp. 4-1 - 4-4). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-CP-517)

Donohue-Perry, M. M., Riegler, J. T., & Hausmann, M. A. (1990). *A compatibility assessment of the protective integrated hood mask with ANVIS night vision goggles* (Report No. AAMRL-TR-90-030). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A229956)

Donohue-Perry, M. M., & Task, H. L. (1988). *An optical evaluation of laser protective visors* (Report No. AAMRL-TR-88-053). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B133750)

Donohue-Perry, M. M., & Task, H. L. (1994). *Visual acuity vs. field-of-view and light level for night vision goggles* (Report No. AL/CF-TR-1994-0076). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A284750)

Donohue-Perry, M. M., Task, H. L., & Dixon, S. A. (1994). Visual acuity vs. field of view and light level for Night Vision Goggles (NVGs). In R. J. Lewandowski, W. Stephens, & L. A. Haworth (Ed.), *Proceedings of the Society of Photo-Optical Instrumentation Engineers (SPIE): Helmet- and Head-Mounted Displays and Symbology Design Requirements, 2218*, 71-81.

Doyal, J. A., Irvin, G. E., Donohue, T. R., & Dowler, M. G. (1992). Flight simulation of infrared smoke obscuration using equivalent contrast reduction. *Proceedings of the Smoke/ Obscurants Symposium*, 24.

Doyal, J. A., Ramer, D. P., Stratton, M. D., & Purvis, B. D. (1994). *Visual contrast detection thresholds for aircraft contrails* (Report No. AL/ CF-TR-1994-0116). Wright-Patterson AFB, OH: Armstrong Laboratory.

Eggemeier, F. T., & Wilson, G. F. (1991). Performance-based and subjective assessment of workload in multi-task environments. In D. L. Damos (Ed.), *Multiple task performance* (pp. 217-278). London: Taylor & Francis.

Eggemeier, F. T., Wilson, G. F., Kramer, A. F., & Damos, D. L. (1991). Workload assessment in multi-task environments. In D. L. Damos (Ed.), *Multiple task performance* (pp. 207-216). London: Taylor & Francis.

Eggleston, R. G. (1986). *Apparent motion and prior correspondence effects in visual perception* (Report No. AAMRL-TR-86-027). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A174424)

Eggleston, R. G. (1987). The changing nature of the human-machine design problem: Implications for system design and development. In W. B. Rouse, & K. R. Boff (Eds.), *System design: Behavioral perspectives on designers, tools, and organizations* (pp. 113-125). New York: North Holland.

Eggleston, R. G. (1987). *Impact of future developments in electronic technology on cockpit engineering* (Report No. AGARD-R-757). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-R-757)

Eggleston, R. G. (1988). Machine intelligence and crew-vehicle interfaces. In E. Heer, & H. Lum (Eds.), *Progress in astronautics and aeronautics: Vol. 115. Machine intelligence and autonomy for aerospace systems* (pp. 51-84). Washington, DC: American Institute of Aeronautics.

Eggleston, R. G. (1992). Cognitive interface considerations for intelligent cockpits. *AGARD Conference Proceedings 520: Flight Mechanics and Guidance and Control Panel Symposium* (pp. 21-1 - 21-16). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-CP-520)

Eggleston, R. G., Chechile, R. A., Fleischman, R. N., & Sasseville, A. (1986). Modeling the cognitive complexity of visual displays. *Proceedings of the Human Factors Society 30th Annual Meeting, 1*, 675-678.

Eggleston, R. G., Janson, W., & Adapalli, S. (1994). Manual tracking performance using a virtual hand controller: A comparison study. *AGARD Conference Proceedings 541: Virtual Interfaces: Research and applications.* Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-CP-541)

Eimer, E. O. (1987). *Team problem solving: Effects of communication and function overlap* (Report No. AAMRL-TR-87-037). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A187010)

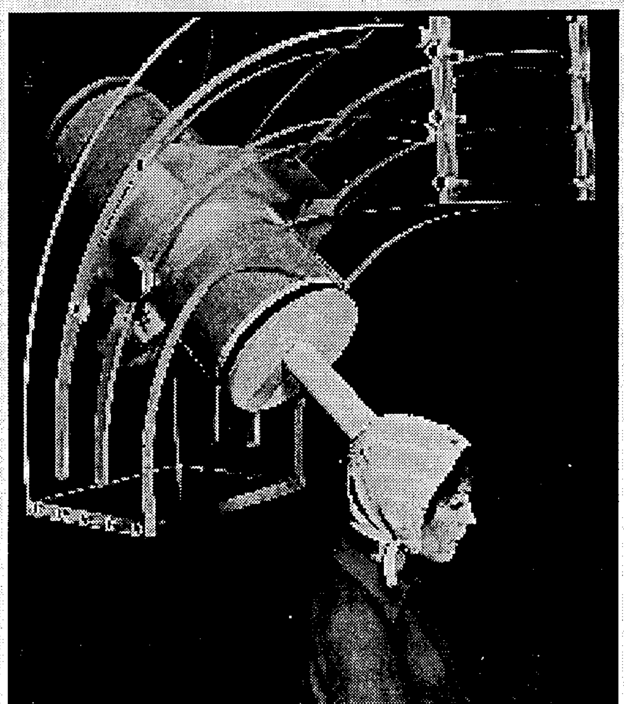
Eimer, E. O. (1987). *When decision aids fail* (Report No. AAMRL-TR-87-035). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

Endsley, M. R. (1991). *Situation awareness in an advanced strategic mission* (Report No. AL-TR-1991-0083). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B161348)

Endsley, M. R., & Kiris, E. O. (1993). *Information presentation for expert systems in future fighter aircraft* (Report No. AL/CF-TR-1993-0164). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A275126)

Entin, E. E., James, R. M., & Serfaty, D. (1987). *Cognitive style and multi-stage decision making* (Report No. AAMRL-TR-87-024). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A183891)

Ervin, C. A. (1987). *Annotated bibliography of psychomotor testing* (Report No. AAMRL-Technical Report-87-019). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A181694)



MEASURING MAGNETIC FIELDS IN THE BRAIN OF A STRESSED SUBJECT

Ms. Penny Fullenkamp serving as a subject in a stressful task while the locations and intensities of magnetic fields in her brain are measured by the SQUID electronics of a magnetoencephalography (MEG) device. This work is one of a series of investigations of psychophysiological measures of operator workload started by Dr. Glenn F. Wilson. Information about the MEG and other methods for assessing operator workload is available in Dr. Wilson's review of progress in the psychophysiological assessment of workload. AL-TR-1992-0007 (1992) (Task 718414)

Ervin, C. A., & Robinette, K. M. (1987). *A manual for administering a standardized dexterity test battery* (No. AAMRL-TR-87-036). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A188718)

Fang, H., & Nurre, J. H. (1994). *Optimal estimation of head scan data with generalized cross validation* (Report No. AL/CF-TR-1994-0114). Wright-Patterson AFB, OH: Armstrong Labs.

Farley, W. W. (1987). *Design and testing of a luminance and chrominance stabilization system for a computer-controlled color display* (Report No. AAMRL-TR-87-027). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A955697)

Farmer, E., Boer, L., Goeters, K., Grussett, J., Santucci, G., Schwartz, E., Wetherell, A., & Wilson, G. F. (1989). *AGARDograph 308: Aerospace Medical Panel Working Group 16: Human performance assessment methods.* Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-AG-308)

Filipovich, D. (1992). *Enhanced night vision goggle configuration* (Report No. AL-SR-1992-0017). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B172004)

Filipovich, D., Fiore, J., & Craig, J. (1994). *Enhanced night vision goggle configurations: Concept VI-advanced low profile night vision goggle* (Report No. AL/CF-TR-1994-0099). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B192590)

Filipovich, D., Fiore, J., & Craig, J. L. (1994). *Further development of NVGs: Concept VIII-wide field-of-view night vision goggle* (Report No. AL/CF-TR-1994-0098). Wright-Patterson AFB, OH: Armstrong Laboratory.

Filipovich, D., Sobel, A., & Craig, J. (1994). *Liquid crystal displays within image intensifier systems* (Report No. AL/CF-SR-1994-0011). Wright-Patterson AFB, OH: Armstrong Laboratory.

Fiorita, A. L., Middendorf, M. S., & McMillan, G. R. (1992). Maintaining subject motivation in long-term experiments using performance incentives and penalties. *Proceedings of the Human Factors Society 36th Annual Meeting, 2*, 1335-1339.

Fisher, T. J., Riccio, G. E., & McMillan, G. R. (1986). The effects of simulator delays on the acquisition of flight control skills. *HQ USAF/DFBL 10th Psychology in the DoD Symposium* (USAFA-TR-86-1, Vol 1, pp. 224-228)

Fix, E. L. (1988). Optimizing back propagation training. *Proceedings of the Fourth Annual Aerospace Applications of Artificial Intelligence Conference, 1*, 52-56.

Fix, E. L. (1990). Modeling human performance with neural networks. *Proceedings of the International Joint Conference on Neural Networks, 1*, 247-252.

Fix, E. L. (1990). Neural network based human performance modeling. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 3*, 1162-1165.

Researchers in the department today also use computers to help them develop workplace layouts and equipment designs. In fact, computers have produced "a revolution in systems designs," said Bates. "We have tremendous potential from high-speed computers and miniaturization of computer equipment that allows us to do things aerodynamically that we couldn't before because of the instability of some airframes. The engineer now has incredible design options for the way in which he interfaces the pilot with the airframe and the avionics on the airplane."

— C. Bates, May 1985, "Human Engineering, Yesterday and Today," Civilian Employees Reporter

Fix, E. L. (1990). *Neural network based human performance modeling* (Report No. AAMRL-TR-90-042). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A229822)

Fix, E. L., & Deer, B. C. (1988). Extrapolation and interpolation capability of the back propagation algorithm. *Proceedings of the Fourth Annual Aerospace Applications of Artificial Intelligence Conference, 1*, 87-92.

Fix, E. L., Marshak, W. P., & Burnside, D. (1990). Advanced reference system cockpit display project. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 1*, 338-342.

Fix, E. L., & Rolek, E. P. (1991). *Modeling a human operated Soviet SAM system using neural networks* (Report No. AL-TR-91-0016). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B167818)

Flach, J. M., McMillan, G. R., Warren, R., & Snell, M. K. (1985). The effects of psychophysical matching on the transfer of training between alternative motion simulators. *Proceedings of the Third Symposium on Aviation Psychology*, 601-608.

Flach, J. M., & Warren, R. (in press). Active psychophysics: The relation between mind and what matters. In J. M. Flach, P. A. Hancock, J. Caird, & K. Vicente (Eds.), *The ecology of human-machine systems.* Hillsdale, NJ: Erlbaum.

Flach, J. M., & Warren, R. (in press). Low altitude flight. In J. M. Flach, P. A. Hancock, J. Caird, & K. Vicente (Eds.), *An ecological approach to human machine systems II: Local applications.* Hillsdale, NJ: Erlbaum.

Fracker, M. L. (1988). A theory of situation assessment: Implications for measuring situation awareness. *Proceedings of the Human Factors Society 32nd Annual Meeting, 1*, 102-106.

Fracker, M. L. (1989). Attention allocation in situation awareness. *Proceedings of the Human Factors Society 33rd Annual Meeting, 2*, 1396-1400.

Fracker, M. L. (1989). Attention gradients in situation awareness. *AGARD Conference Proceedings 478: Situation Awareness in Aerospace Operations.* Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-CP-478)

Fracker, M. L. (1991). *Measures of situation awareness: An experimental evaluation* (Report No. AL-TR-1991-0127). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A262732)

Fracker, M. L. (1991). *Measures of situation awareness: Review and future directions* (Report No. AL-TR-1991-0128). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A262672)

Fracker, M. L., & Davis, S. A. (1991). *Explicit, implicit, and subjective rating measures of situation awareness in a monitoring task* (Report No. AL-TR-1991-0091). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A262702)

Fracker, M. L., & Vidulich, M. A. (1991). Measurement of situation awareness: A brief review. *Proceedings of the 11th Congress of the International Ergonomics Association, 1,* 795-797.

Fracker, M. L., & Wickens, C. D. (1987). Resources, confusions, and compatibility in dual axis tracking: Displays, controls, and dynamics. *Proceedings of the Human Factors Society 31st Annual Meeting, 2,* 1211-1215.

Fracker, M. L., & Wickens, C. D. (1989). Resources, confusions and compatibility in dual axis tracking: Displays, controls, and dynamics. *Journal of Experimental Psychology: Human Perception and Performance, 15*(1), 80-96.

Franklin, H. (1993). *Miniature color display phase IV final report* (Report No. AL/CF-SR-1993-0009). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A272920)

Fraser, N. M., Hipel, K. W., & Kilgour, D. M. (1987). *Human conflict resolution* (Report No. AAMRL-TR-87-013). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A182740)

Fraser, N. M., Hipel, K. W., Kilgour, D. M., McNeese, M. D., & Snyder, D. E. (1989). An architecture for integrating expert systems. *Decision Support Systems, 5,* 263-276.

Frazier, J., McDaniel, J. W., Skowronski, V., & Aume, N. M. (1988). *Body displacement measured during sustained +Gz, -Gz, and +/-Gy acceleration using a stereoscopic photographic system* (Report No. AAMRL-TR-88-015). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A197988)

Freeman, J., Hesse, K., Sáuerborn, J., & Sluzky, E. (1987). *Performance improvement of miniature cathode ray tubes* (Report No. AAMRL-TR-87-062). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B145068)

Frick, R. K., Hooever, R., Campbell, B., Cotton, F., Aaranson, J., Kuperman, G. G., & Wilson, D. (1986). *RT mission scenario description* (Report No. AAMRL-TR-86-044). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. C036399)

Frick, R. K., Swinehart, R., & Taylor, M. (1987). *Functional requirements/systems architecture for Relocatable Target (RT) missions, Vol. II: User's guide to models* (Report No. AAMRL-TR-87-028). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B116589)

Frick, R. K., Swinehart, R., Taylor, M., Kuperman, G. G., & Wilson, D. L. (1987). *Functional requirements/systems architecture for Relocatable Target (RT) missions, Volume I: Methodology* (Report No. AAMRL-TR-87-068). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. C955978)

Furness, T. A. (1986). The super cockpit and its human factors challenges. *Proceedings of the Human Factors Society 30th Annual Meeting, 1,* 48-52.

Furness, T. A. (1988). Harnessing virtual space. *Society for Information Display International Symposium: Digest of Technical Papers, 19,* 4-7.

Furness, T. A., & Kocian, D. F. (1986). Putting humans in virtual space. *Proceedings of the Conference on Aerospace Simulation II: Society for computer simulation,* 214-230.

Gallimore, J. J. (1992). *Review of psychophysically-based image quality metrics* (Report No. AL-TR-1991-0153). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A251053)

Garcia, L. (1994). A tool for design traceability management. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 2,* 807-813.

Garness, S. A., Flach, J. M., Stanard, T., & Warren, R. (1994). The basis for the perception and control of altitude: Splay & depression angle components of optical flow. *Proceedings of the Human Factors and Ergonomics Society 38th Annual Meeting, 2,* 1275-1279.

Gawron, V. J., Bailey, R. E., Knotts, L. H., & McMillan, G. R. (1989). Comparison of time delay during in-flight and ground simulation. *Proceedings of the Human Factors Society 33rd Annual Meeting, 1,* 120-123.

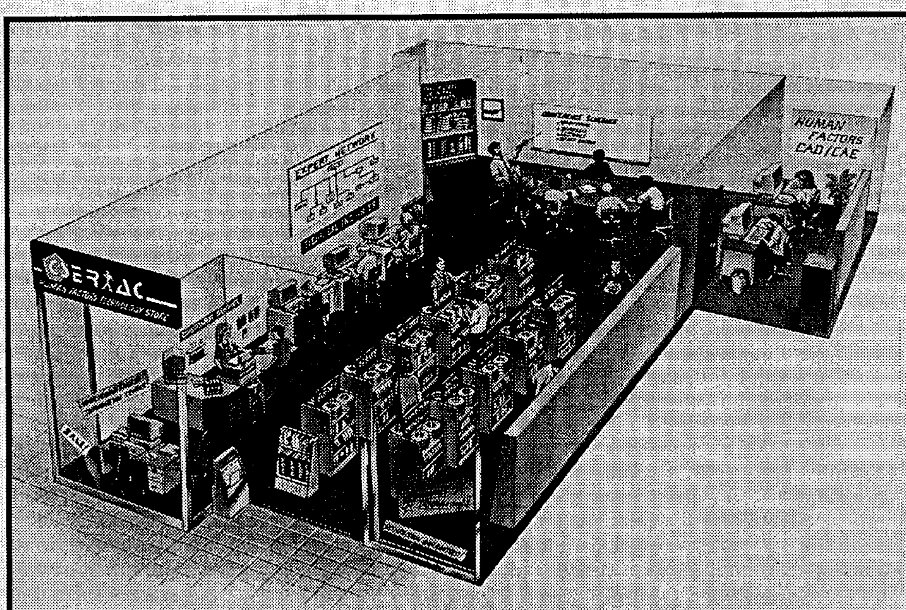
Geiselman, E. E., & Osgood, R. K. (in press). Helmet-mounted display attitude symbology: An evaluation of compression ratio. *The International Journal of Industrial Ergonomics.*

Geiselman, E. E., & Osgood, R. K. (1992). A comparison of three attitude display symbology structures during an attitude maintenance task. *Proceedings of the Human Factors Society 36th Annual Meeting, 2,* 1450-1454.

Geiselman, E. E., & Osgood, R. K. (1993). *A comparison of three aircraft attitude display symbology structures* (Report No. AL/CF-TR-1993-0134). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A275172)

Geiselman, E. E., & Osgood, R. K. (1993). Toward an empirically based helmet-mounted display symbology set. *Proceedings of the Human Factors and Ergonomics Society 37th Annual Meeting, 1,* 93-97.

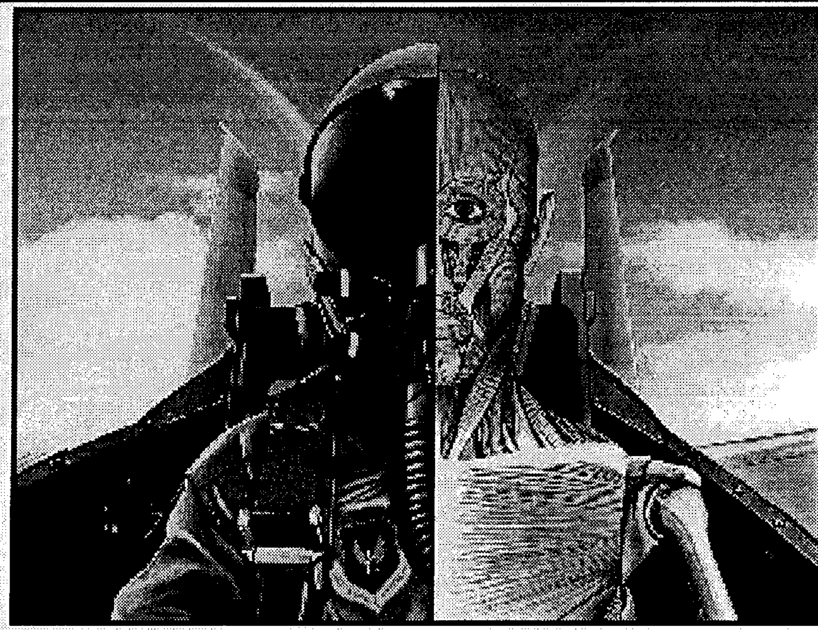
CSERIAC



The Crew System Ergonomics Information Analysis Center (CSERIAC) is the central source for up-to-date human factors information and technologies. Human factors, or ergonomics, attempts to understand and quantify human physiological and behavioral interactions with equipment and systems. Prior to 1988, designers and engineers had no resource for complete human factors information. In response to this need, Dr. Kenneth R. Boff, of the Human Engineering Division, Armstrong Laboratory, conceived and established CSERIAC. Operated by the University of Dayton Research Institute, CSERIAC is a Defense Technical Information Center/Department of Defense organization, managed by the Human Engineering Division at Wright-Patterson Air Force Base, in Ohio.

What Do We Do?

CSERIAC's mission is to provide a quick and reliable source for analytical services, topical publications, software programs, and databases pertaining to human factors. We collect, analyze, and disseminate information and technologies to support the requirements of all parties within the government, industrial, and academic sectors concerned with human-machine systems. We strive to be the premier gateway for the dissemination of human factors-related information and technologies. In short, CSERIAC solves your human factors problems.



BIOFIDELIC VIRTUAL PEOPLE
An illustration depicting future life-like human models, referred to as "biofidelic" models, that will be used to design, test, and "try on" equipment within a highly graphic computer environment. The term biofidelic was coined by Mrs. Jennifer Whitestone. (Workunit 71840846)

Geiselman, E. E., & Osgood, R. K. (1994). Utility of off-boresight helmet-mounted symbology during a high angle airborne target acquisition task. In R. J. Lewandowski, W. Stephens, & L. A. Haworth (Eds.), *Proceedings of the Society of Photo-Optical Instrumentation Engineers (SPIE): Helmet- and Head-Mounted Displays and Symbology Design Requirements, 2218*, 328-338.

Gibbons, J. R., Llinas, J., Wilson, D. L., & Kuperman, G. G. (1986). *Strategic conventional standoff capability: High resolution radar demonstration project workload analysis approach* (Report No. AAMRL-TR-86-013). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B102292)

Gibbons, L. E. (1990). *Summary of ergonomics research for the CREW CHIEF model development* (AAMRL-TR-90-038). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A236113)

Gibson, C. P., & Martin, W. L. (1989). Designing the virtual cockpit man-machine interface. *Proceedings of the Society of Photo-Optical Instrumentation Engineers (SPIE): Display System Optics II, 1117*, 85-93.

Gill, R. T., Kenner, K. M., & Junker, A. M. (1986). Steady state EEG as a measure of peripheral light loss. *Proceedings of the Human Factors Society 30th Annual Meeting, 2*, 1249-1253.

Gilliland, K., Schlegel, R. E., & Dannels, S. (1987). Relationship between Criterion Task Set performance and the personality variables of sensation seeking and stimulus screening. *Proceedings of the Human Factors Society 31st Annual Meeting, 1*, 402-404.

Givens, B. R. (1994). Object-oriented applications in a rapid prototyping environment. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 2*, 814-819.

Gleason, G. A., Schor, C., Lunn, R., & Maxwell, J. (1993). Directionally selective short-term nonconjugate adaptation of vertical pursuits. *Vision Research, 33*(1), 65-71.

Glushko, R. J., Weaver, M. D., Coonan, T. A., & Lincoln, J. E. (1988). Hypertext engineering: Practical methods for creating a compact disc encyclopedia. *Proceedings of the ACM Conference on Document Processing Systems*, 11-19.

Goldman, Z. Z. (1988). *Human auditory and visual unimodal and bimodal continuous evoked potentials* (Report No. AAMRL-TR-88-016). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A198845)

Gomes, M. E., Lind, S., & Snyder, D. E. (1992). *A human factors evaluation of the MH-53J helicopter using advanced acquisition and computer analysis techniques* (Report No. AL-TR-1992-0081). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B170365)

Gonsalves, P. G., Kneller, E. W., Zacharias, G. L., St. John, R. J., & Purvis, B. D. (1989). *Model-based method for terrain-following display design* (AAMRL-TR-89-039). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC A219302)

Green, R. J. (1994). *Bibliography of research reports and publications issued by the Human Engineering Division, January 1987 - December 1993* (Report No. AL/CF-SR-1994-0003). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A278787)

Green, T. B., Purvis, B. D., & Marshak, W. P. (1989). Strategic aircraft engineering design simulation. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 2,* 742-745.

Grigsby, S. S., Rogers-Adams, B., & Tsou, B. H. (1994). Binocular summation of tonic and phasic stimuli in the near and far periphery [Abstract]. *Investigative Ophthalmology and Visual Science, 35,* 1917.

Grigsby, S. S., & Tsou, B. H. (1993). Monocular and binocular grating and flicker sensitivity across the visual field. *Investigative Ophthalmology and Visual Science, 34,* 779.

Grigsby, S. S., & Tsou, B. H. (1993). Visual factors in the design of partial overlap binocular helmet-mounted displays. *Society for Information Display International Symposium: Digest of Technical Papers, 24,* 185-187.

Grigsby, S. S., & Tsou, B. H. (1994). Grating and flicker sensitivity in the near and far periphery: Naso-temporal asymmetries and binocular summation. *Vision Research,* (34), 2842-2848.

Grigsby, S. S., & Tsou, B. H. (1994). Visual processing and partial-overlap head-mounted displays. *Journal of the Society for Information Display, 2*(2), 69-73.

Grove, R. (1992). *Interim-Night Integrated Goggle Head Tracking System (I-NIGHTS) final report, Volume II: Flight test pilot survey report* (Report No. AL-TR-1992-0087). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A 282400)

Gundel, A., & Wilson, G. F. (1992). Topographical changes in the ongoing EEG related to the difficulty of mental tasks. *Brain Topography, 5*(1), 17-25.

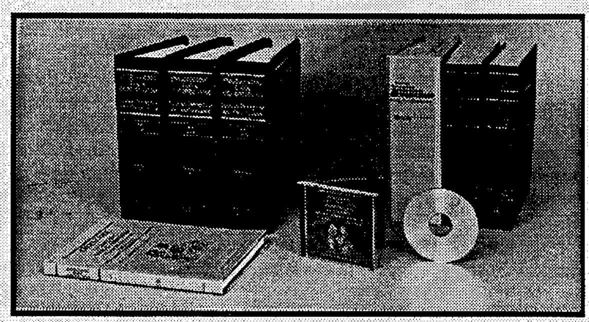
Gundel, A., & Wilson, G. F. (1993). Editorial: Psychophysiological measures in transport operations [Special issue]. In A. Gundel, & G. F. Wilson (Ed.), *Ergonomics, 36*(9), 989.

Gunderman, R., & Stiffler, J. (1992). *Interim-Night Integrated Goggle Head Tracking System (I-NIGHTS) final report, Volume I: Ground test summary* (Report No. AL-TR-1992-0087). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A 282399)

Haas, M. W. (1992). Multi-sensory virtual-interface technology. *AGARD 25th Anniversary Seminar.* Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development.

Haas, M. W. (1993). Fusion interfaces for tactical environments: An approach for applying virtual reality technology. In L. Murray (Ed.), *Minutes of the 30th Meeting of the DOD Human Factors Engineering Technical Advisory Group* (pp. AA).

Haas, M. W. (1994). Fusion interfaces for tactical environments: An approach for applying virtual reality technology. In K. Krishen (Ed.), *Seventh Annual Workshop on Space Operations, Applications and Research (SOAR '93)* (NASA CP-3240, Vol 1&2, pp. 378-387). Washington, DC: National Aeronautics and Space Administration.



THE HUMAN ENGINEERING DATA COMPENDIUM

Engineering Data Compendium, Human Perception and Performance (1988), edited by K.R. Boff and J.E. Lincoln, an extensive three-volume, in-depth treatment of the basic data on perception and performance (also shown on CD-ROM) for use by the human engineering specialist and an efficient basis for access to the research literature. The figure also shows the primary reference for the Compendium, the two-volume "Handbook of Perception and Human Performance" (1986). These volumes are a unique source of data for guiding trade-offs between the characteristics of humans and machines in designing efficient man-machine systems by fitting the machine to its human users. (Workunit 71842607)

Haas, M. W., & Hettinger, L. J. (1993). Applying virtual reality technology to cockpits of future fighter aircraft. *Virtual Reality Systems, 1*(2), 18-26.

Haas, M. W., & Wells, M. J. (1990). Head movement during simulated air-to-air engagements. *Proceedings of the Society of Photo-Optical Instrumentation Engineers (SPIE): Helmet-Mounted Displays II, 1290,* 246-257.

Hall, P. S., & Campbell, B. L. (1992). Helmet-mounted systems technology planning. *Proceedings of the Society of Photo-Optical Instrumentation Engineers (SPIE): Helmet-Mounted Displays III, 1695,* 2-7.

Hammond, K. R. (1987). *Reducing disputes among experts* (Report No. AAMRL-TR-87-015). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A182602)

Harmon, E. E., May, J. G., Love, A. C., Cannon, M. W., & Ellis, G. S. (1988). Infant preferences: Faces vs. a blooming buzzing confusion. *Investigative Ophthalmology and Visual Science, 29,* 25.

Haskell, B. E., & Reid, G. B. (1987). The subjective perception of workload in low time private pilots. *Aviation, Space and Environmental Medicine,* 1230-1232.

Hecht-Nielsen, R., & John, E. R. (1994). *Mental workload measurement using brainwave analysis* (Report No. AL/CF-SR-1994-0008). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B187319)

Hecht-Nielsen, R., Rossen, M. L., & John, E. R. (1991). *Mental workload measurement using brainwave analysis* (Report No. AL-SR-1991-0003). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B154362)

Hedges, G. (1992). *Support of the evaluation of night vision devices* (Report No. AL-SR-1992-0019). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B182038)

Hennessy, R. T., & McCauley, M. E. (1986). *Proposal and justification to establish a department of defense crew systems ergonomics information analysis center (CSERIAC)* (Report No. AAMRL-TR-86-022). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A181555)

Hettinger, L. J., Donohue-Perry, M. M., Riegler, J. T., & Davis, S. A. (1992). *Night Vision Goggle (NVG) users' concerns survey site report: Eglin AFB, FL* (Report No. AL-TR-1992-0144). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B174198)

Hettinger, L. J., Donohue-Perry, M. M., Riegler, J. T., & Davis, S. A. (1993). *Night Vision Goggle (NVG) users' concerns survey site report: Fairchild AFB, WA* (Report No. AL/CF-TR-1993-0094). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B178368)

Hettinger, L. J., Donohue-Perry, M. M., Riegler, J. T., & Davis, S. A. (1993). *Night Vision Goggle (NVG) users' concerns survey site report: Robins AFB, GA* (Report No. AL/CF-TR-1993-0070). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B178296)

Hettinger, L. J., Nelson, W. T., & Haas, M. W. (1994). Applying virtual environment technology to the design of fighter aircraft cockpits: Pilot performance and situation awareness in a simulated air combat task. *Proceedings of the Human Factors and Ergonomics Society 38th Annual Meeting, 1,* 115-118.

Hettinger, L. J., Nelson, W. T., & Haas, M. W. (1994). Comparison of target detection performance using a helmet-mounted display and a conventional flight simulator dome display. *Proceedings of the '94 Symposium on Human Interaction with Complex Systems.*

Hoffmeister, J. W. (1994). Better fitting burn masks. In K. Hart (Ed.), *The OATC Innovator, 94*(3), 5-7.

Horwitz, L. S., & Griffith, O. (1992). *Ocular vergence and accommodation sensor for helmet-mounted displays* (Report No. AL-SR-1992-0018). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B178051)

Hunt, G., Armando, A., Brants, I. J. H., Haas, M. W., Leutwyler, R., Parus, R., Beaton, R. M., Deblon, F., Hulme, A., & Pagniz, P. (1992). *Mission planning systems for tactical aircraft (pre-flight and in-flight)* (Report No. AGARD-AR-313). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-AR-313)

Hunt, G., Jones, T. N., Armando, A., Brants, I. J. H., Haas, M. W., Leutwyler, R., Beaton, R. M., Deblon, F., Hulme, A., & Parus, R. (1991). *Mission planning systems for tactical aircraft (pre-flight and in-flight)* (Report No. AGARD-AR-296). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-AR-296)

Hunt, R. M. (1987). The difficulties of design problem formulation. In W. B. Rouse, & K. R. Boff (Eds.), *System design: Behavioral perspectives on designers, tools and organizations* (pp. 145-157). New York: North Holland.

Hutton, R. J. B., Flach, J. M., Brickman, B. J., Dominguez, C. O., Hettinger, L., Haas, M., & Russell, C. (1994). Keeping in touch: Kinesthetic-tactile information and fly-by-wire. *Proceedings of the Human Factors and Ergonomics Society 38th Annual Meeting, 1*, 26-30.

Ingling, C. R., Jr., & Tsou, B. H. (1988). Spectral sensitivity for flicker and acuity criteria. *Journal of the Optical Society of America, 5*, 1374-1378.

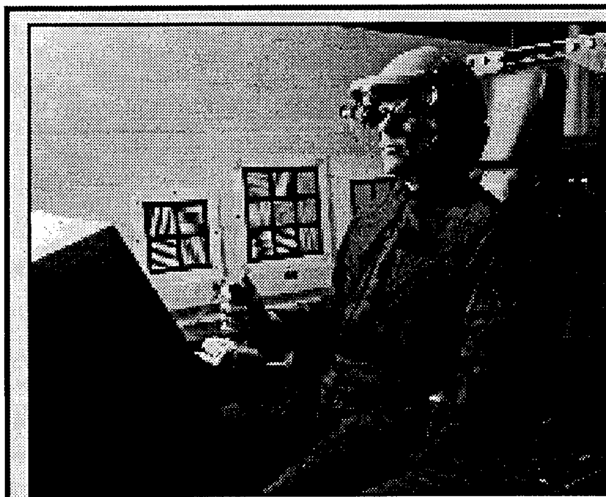
Irvin, G. E., Donohue, T. R., & Dowler, M. G. (1994). *Evaluation and specification of chromaticity coordinates for an effective concrete False Operating Surface (FOS)* (Report No. AL/CF-TR-1994-0035). Wright-Patterson AFB, OH: Armstrong Laboratory.

Irvin, G. E., & Dowler, M. G. (1992). Physiologically based computational approach to camouflage and masking patterns. *Proceedings of the Society of Photo-Optical Instrumentation Engineers (SPIE)*, 481-488.

Irvin, G. E., & Kang, R. N. (1987). Perimetry measures of transient visual field loss in the presence of foveal laser exposures in humans. *Proceedings of the Sixth DOD Conference on Directed Energy Weapons: Vulnerability, Survivability and Effects.*

Irvin, G. E., Kang, R. N., Spravka, J. J., & O'Neal, M. R. (1988). Correlational investigation of contrast sensitivity and visual acuity in the detection of approaching aircraft [Abstract]. *Aviation, Space and Environmental Medicine, 59*(5), 463.

Irvin, G. E., Keep, G. F., & Dowler, M. G. (1991). Two-dimensional aircraft decoys based on perspective rendition: Overview and



ADVANCED NIGHT VISION GOGGLES RESEARCH

Mr. Pete Marasco evaluates the latest high-tech night vision goggle (NVG) system capable of displaying a 45-degree intensified field-of-view on optical combiners. (Task 718418)

experimental results. *Proceedings of the Aerospace Medical Association Convention*, 450.

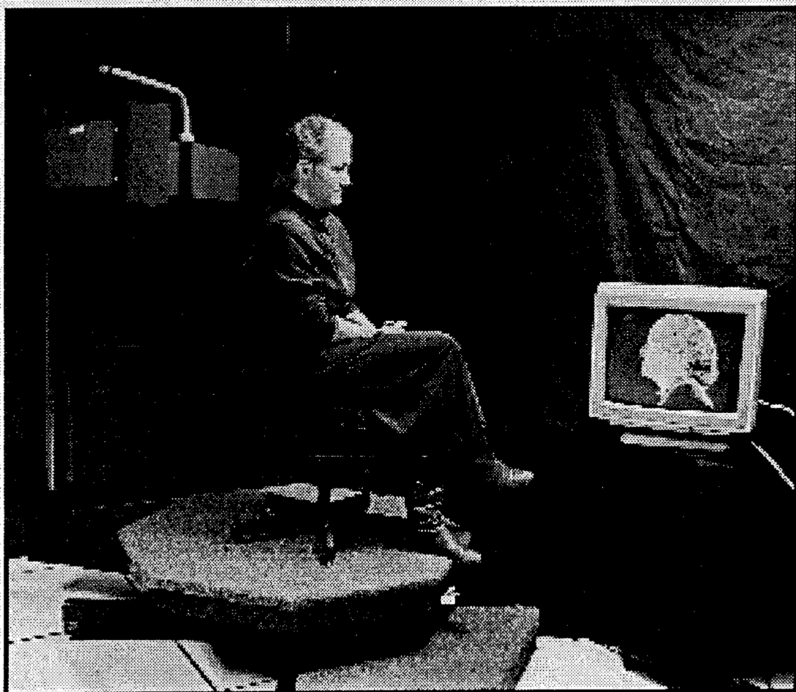
Irvin, J. G., Doyal, J. A., Sharp, E. D., & LaSalvia, J. M. (1994). *Experimental evaluation of cursors for B-2 Synthetic Aperture Radar (SAR) application* (Report No. AL/CF-TR-194-0020). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A283025)

Janson, W. P. (1989). *Eye and head response to peripheral targets* (Report No. AAMRL-TR-89-033). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A234958)

Janson, W. P., & Calhoun, G. L. (1988). Latencies of the eye & head to targets in the vertical & horizontal planes. *Proceedings of the Human Factors Society 32nd Annual Meeting, 2*, 1424-1428.

Janson, W. P., Quam, D. L., & Calhoun, G. L. (1987). Eye & head displacement to targets fixated in the vertical & horizontal planes. *Proceedings of the Human Factors Society 31st Annual Meeting, 1*, 243-247.

Jauer, R. A., Quinn, T. J., Hockenberger, R. L., & Eggleston, R. G. (1986). *Radar aided mission/aircraft capability exploration RAM/ACE - Full task simulation study* (Report No. AAMRL-TR-86-015). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B107949)



LASER SCANNING A HUMAN HEAD
Ms. Kathleen M. Robinette being surface scanned by a laser scanner which provides high-resolution surface data of her head and face. Her surface features are displayed on the computer graphics terminal. Laser scanning has advanced anthropometric methods at the Computerized Anthropometric Research and Design (CARD) Laboratory of the Human Engineering Division. (1993) (Task 718408)

Jauer, R. A., Quinn, T. J., Hockenberger, R. L., & Eggleston, R. G. (1987). *Radar-aided mission/aircrew capability exploration: Full task simulation study* (Report No. AAMRL-TR-86-015). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B107949)

Jensen, J. G., Brunswick, E. A., & Replogle, C. R. (1993). *Analysis of theater missile defense intercept altitude and kill requirements against chemical and biological agent-filled tactical ballistic missiles* (Report No. AL/CF-TR-1993-0104). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. C960153)

Jensen, J. G., Hany, J. V., Vanderveer, D. E., & James, G. M. (1986). *Chemical warfare challenge to aircrews: Executive summary* (Report No. AAMRL-TR-86-032). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. C039916)

Jensen, J. G., Hany, J. V., Vanderveer, D. E., & James, G. M. (1986). *Chemical warfare challenge to aircrews: Volume I—Analysis and results* (Report No. AAMRL-TR-86-054). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. C040553)

Jensen, J. G., Hany, J. V., Vanderveer, D. E., & James, G. M. (1986). *Chemical warfare challenge to aircrews: Volume II—Appendices* (Report No. AAMRL-TR-86-055). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. C040554)

Johnson, K. L., Brisby, J. M., Prior, R. C., Blazer, D. R., Heaton, H. H., Finch, S. R., Hattershire, B. R., & Sharp, E. D. (1988). *Final report: Strategic Avionics Crew Station Design Evaluation Facility (SACDEF) systems integrator contract* (Report No. AAMRL-TR-88-071). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B131733)

Johnson, S., Shaw, R. L., & Simons, J. C. (1989). *Fighter, bomber, airlift debriefings: I. Facilities and general guidelines* (Report No. AAMRL-TR-89-006). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

Johnson, W. V., & Middendorf, M. S. (1988). Simulator transport delay measurement using steady-state techniques. *AIAA Flight Simulation Technologies Conference*, 250-254.

Jones, G. W. (1993). *Helmet-mounted visual system components and assemblies (b) miniature cathode ray tubes using field emission devices* (Report No. AL/CF-SR-1993-0004). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B190904)

Jones, M. R., & Skelly, J. J. (1993). The role of event time in attending. *Time and Society, 2*(1), 107-128.

Junker, A. M. (1988). Loop closure of the visual cortical response. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON)*, 1523-1529.

Junker, A. M. (1988). A real time frequency analyses methodology for evoked potential loop-closure. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON)*, 1530-1535.

Junker, A. M. (1988). Resource measurement using a closed-loop EEG control system. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON)*, 1519-1522.

Junker, A. M., Kenner, K. M., & Ingle, D. F. (1986). The effect of task difficulty on the steady state visual evoked response. *Proceedings of the Human Factors Society 30th Annual Meeting, 2*, 1254-1258.

Junker, A. M., Levison, W. H., & Gill, R. T. (1987). *A systems engineering based methodology for analyzing human electrocortical responses* (Report No. AAMRL-TR-87-030). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A190809)

Junker, A. M., Schnurer, J. H., Ingle, D. F., & Downey, C. W. (1988). *Loop-closure of the visual-cortical response* (Report No. AAMRL-TR-88-014). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A198348)

Kama, W. N. (1988). *The effect of binocular rivalry on the performance of a simple target detection/recognition task* (Report No. AAMRL-TR-88-056). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A203512)

Kama, W. N. (1989). Measures of distortion: Are they relevant? In S. A. Marolo (Ed.), *Conference on Aerospace Transparent Materials and Enclosures* (WRDC-TR-89-4044, Vol. 2, pp. 1072-1093). Wright-Patterson AFB, OH: Wright Research and Development Center.

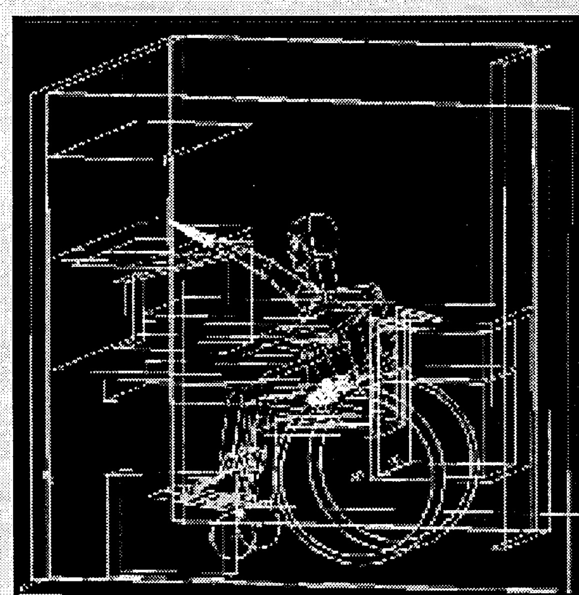
Kama, W. N., Bridenbaugh, J., & Task, H. L. (1987). *Flexible fiber optics bundle study: Effect of number of active fibers on symbol legibility* (Report No. AAMRL-TR-87-012). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

Kama, W. N., & Kuperman, G. G. (1988). *The effect of HUD symbology size on operator performance under various luminance conditions* (Report No. AAMRL-TR-88-021). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A210460)

Kama, W. N., Task, H. L., & Merkel, H. S. (1988). *Field and laboratory evaluation of the optical qualities of the B-1B windshield* (Report No. AAMRL-TR-88-050). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B147487)

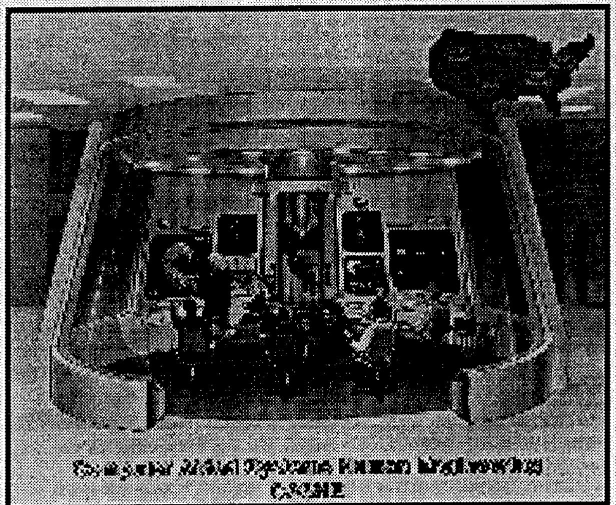
Kang, R. N., Marshak, W. P., Riegler, J. T., Irvin, G. E., & Rogers-Adams, B. M. (1987). *The effect of internal contrast and simulated shadow on the deceptive effectiveness of aircraft silhouette paint pattern decoys* (Report No. AAMRL-TR-87-073). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B128218)

Kang, R. N., Riegler, J. T., & Irvin, G. E. (1987). *Tonedown guidelines for F-16 aircraft canopy shelter entrances* (Report No. AAMRL-TR-87-054). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B119227)



MODIFY WORKPLACES FOR THE PHYSICALLY DISABLED

The COMBIMAN computer model was used to evaluate the physical accommodation of a physically disabled woman in 1993. This proof of concept led to the development of a new program to help modify workplaces to accommodate disabled persons.



CASHE VISION

This Computer-Aided Systems Human Engineering (CASHE) vision shows a multi-disciplinary design team working with a CAD/CAE system in which ergonomic data is a "full partner" among other disciplines within the working environment. The combined use of integrated CRTs, small group wall displays, auditory systems, and virtual display technologies allows designers to fully visualize and experience the operational impact of the crew system design, even in its early conceptual design phase. All team members can interactively communicate their design proposals and solutions to other centers in this distributed design network.

Kang, R. N., Riegler, J. T., Irvin, G. E., & Katz, L. (1987). *An evaluation of the deceptive effectiveness of 2-Dimensional aircraft silhouette patterns as a function of azimuth and contrast in a grouping context* (Report No. AAMRL-TR-87-023). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B111844)

Kang, R. N., Susnik, R. M., Irvin, G. E., & Urban, K. E. (1987). *Target masking-perimeter evaluation of target masking at 530.9 NM and 647.1 NM* (Report No. AAMRL-TR-87-061). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. C043778)

Kang, R. N., Susnik, R. M., & Riegler, J. T. (1987). *The evaluation of 2-Dimensional aircraft silhouette joint patterns as a countermeasure for target acquisition* (Report No. AAMRL-TR-87-022). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B112747)

Kapasouris, P., Serfaty, D., Wohl, J. G., Deckert, J. C., & Pattipati, K. (1989). *Mapping missions onto C3 organizations: Incorporating the goal dimension in IAT* (Report No. AAMRL-TR-89-048). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A225582)

Katsuyama, R. M., McNeese, M. D., & Schertler, D. (1987). The effects of stimulus familiarity upon lateral asymmetry in face recognition. In J. M. Flach (Ed.), *Proceedings of the Fourth Midcentral Ergonomics/Human Factors Conference*, 306-312.

Katsuyama, R. M., Monk, D. L., & Rolek, E. P. (1989). Effects of visual display separation upon primary and secondary task performance. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 2*, 758-764.

Katsuyama, R. M., Rolek, E. P., Johnson, S., & Monk, D. L. (1989). *Effects of miniature CRT location upon primary and secondary task performances* (Report No. AAMRL-TR-89-018). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A210223)

Keep, G. F., Irvin, G. E., & Dowler, M. G. (1991). Aircraft masking patterns as a deception technique: Experimental results from laboratory and field evaluations. [Abstract]. *Proceedings of the Aerospace Medical Association Convention*, 450.

Kelly, L., Flach, J. M., Garness, S., & Warren, R. (1993). Altitude control effects of texture and optical flow. *Proceedings of the Seventh International Symposium on Aviation Psychology, 1*, 292-295.

Kennedy, K. W. (1986). *The derivation of low profile and variable cockpit geometries to achieve 1st to 99th percentile accommodation* (Report No. AAMRL-TR-86-016). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

Kennedy, R. S., Jones, M. B., & Baltzley, D. R. (1989). *Regions of isoperformance: An interactive software package for trading off training, personnel, and equipment* (Report No. AAMRL-TR-89-003). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B136770)

Kenner, K. M., Junker, A. M., & Levison, W. H. (1994). *A linear, dynamic model for the visual-cortical evoked response system* (Report No. AL/CF-SR-1994-0005). Wright-Patterson AFB, OH: Armstrong Laboratory.

Kimble, C. E., & McNeese, M. D. (1987). *Emergent leadership and team effectiveness on a team resource allocation task* (Report No. AAMRL-TR-87-064). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A192105)

Klein, G. A., & Brezovic, C. P. (1987). *Human performance data needed for training device design decisions* (Report No. AAMRL-TR-87-010). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A185988)

Klinger, D. W., Andriole, S. J., Militello, L. G., Adelman, L., Klein, G., & Gomes, M. E. (1993). *Designing for performance: A cognitive systems engineering approach to modifying an AWACS human-computer interface* (Report No. AL/CF-TR-1993-0093). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A275187)

Kocian, D. F. (1988). Design considerations for Virtual Panoramic Display (VPD) helmet systems. *AGARD Conference Proceedings 425: The Man-Machine Interface in Tactical Aircraft Design and Combat Automation* (pp. 22-1 - 22-32). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-CP-425)

Kocian, D. F. (1988). Integrated Helmet Systems (IHS) for binocular helmet mounted displays. *Report of the 30th Meeting of Air Standardization Coordination Committee (ASCC) Working Party 61: Aerospace Medical and Life Support Systems Symposium: Head Protection Issues* (Vol. 4, pp. M-14-1 - M-14-24). Toronto: Defence and Civil Institute of Environmental Medicine.

Kocian, D. F. (1989). Design considerations for visually coupled systems and their interface to sensor/computer generated cockpit imagery systems. In L. M. Biberman (Ed.), *Proceedings of the Sensor Display Workshop: Vol. 2 Display Technology* (IDA Document D-713, pp. 75-194). Alexandria, VA: Institute for Defense Analysis.

Kocian, D. F. (1990). Visually Coupled Systems (VCS): Preparing the engineering research framework. *Eleventh Annual IEEE/AESS Dayton Chapter Symposium: The Cockpit of the 21st Century—Will High Tech Payoff?*, 28-38.

Kocian, D. F. (1991). Visually Coupled Systems (VCS): The Virtual Panoramic Display (VPD) "system." In K. Krishen (Ed.), *Fifth Annual Workshop on Space Operations, Applications, and Research (SOAR '91)* (NASA CP-3127, Vol. 2, pp. 548-561). Washington, DC: National Aeronautics and Space Administration.

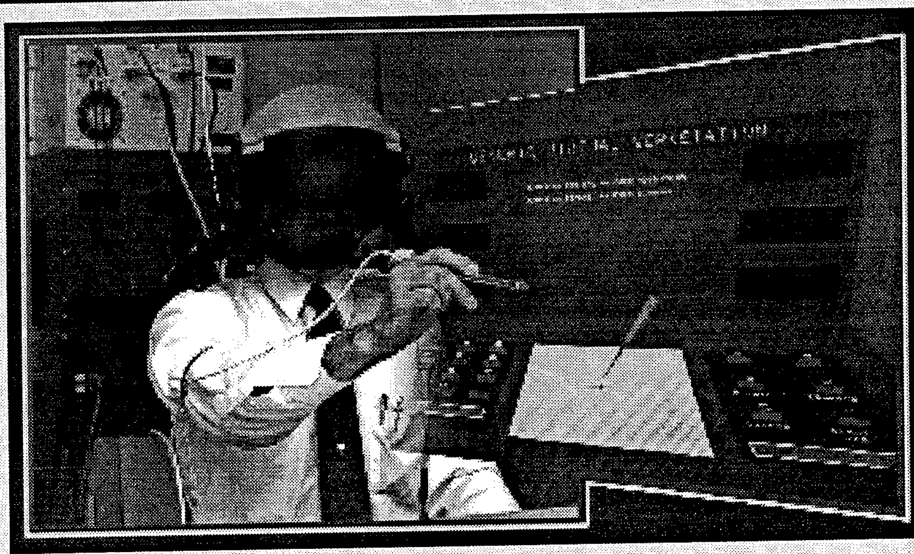
Kocian, D. F. (1993). Helmet mounted displays, miniature cathode-ray tubes, CRT interfaces and miniature color displays, a potpourri. *SID and IICS Symposium: Displays! The Key to Virtual Reality* (pp. 39-71). Playa del Rey, CA: Society of Information Display.

Kocian, D. F., & Task, H. L. (in press). Visually coupled systems hardware and the human interface. In W. Barfield, & T. A. Furness (Eds.), *Virtual Environments & Advanced Interface Design* (pp. 175-257). New York, NY: Oxford University Press.

Korna, M., Krauskopf, P. J., Haddox, D., Hardyal, S., Jones, M. W., Polzinetti, J., & McDaniel, J. W. (1988). *User's guide for CREW CHIEF: A computer graphics simulation of an aircraft maintenance technician (Version 1 - CD20)* (Report No. AAMRL-TR-88-034). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A201368)

Korna, M., Krauskopf, P. J., Haddox, D., Hardyal, S., Jones, M. W., Polzinetti, J., & McDaniel, J. W. (1990). *User's guide for CREW CHIEF: A computer graphics simulation of an aircraft maintenance technician (Version 2 - CD21)* (Report No. AAMRL-TR-90-014). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A230654)

Korna, M., & McDaniel, J. W. (1985). *User's guide for COMBIMAN programs (Computerized Biomechanical Man-Model), Version 7* (Report No. AAMRL-TR-85-057). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.



VIRTUAL WORKSTATIONS
Bill Janson who works with Dr. Robert Eggleston in the Virtual Environment Interface Laboratory (VEIL) is pointing the way to virtual reality!

Korna, M., Rothey, J., Jones, M. W., Krauskopf, P. J., Stump, W., Hardyal, S., Haddox, D., Meeks, L., & McDaniel, J. W. (1988). *User's guide for CREW CHIEF: A computer graphics simulation of an aircraft maintenance technician (Version 1 - CV4001)* (Report No. AAMRL-TR-88-045). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A204869)

Kornfeld, J. R. (1985). *Specification and preliminary validation of IAT methods: Executive summary* (AFAMRL Technical Report 85-003). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Krauskopf, P. J., Jones, M. W., Stump, W. J., & Quinn, J. W. (1990). *CREW CHIEF CAD system interface guide (Version 2 - SI)* (Report No. AAMRL-TR-90-015). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A231433)

Krauskopf, P. J., Quinn, J. W., Berlin, R., Stump, W. J., Gibbons, L. E., & McDaniel, J. W. (1989). *User's guide for COMBIMAN programs (COMputerized BIomechanics MAN-model) Version 8* (Report No. AAMRL-TR-89-024). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A222735)

Kuipers, J. B. (1994). *Characterization and application of quaternions for enhanced computer processing algorithms* (Report No. AL/CF-SR-1994-0014). Wright-Patterson AFB, OH: Armstrong Laboratory.

Kulwicki, P. V., McDaniel, J. W., & Guadagna, L. M. (1987). Advanced development of a cockpit automation design support system. *AGARD Conference Proceedings 417: The Design, Development, and Testing of Complex Avionics Systems* (pp. 19-1-19-15). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-CP-417)

Kuperman, G. G. (1985). *Bandpass spatial filtering and information content* (AAMRL Technical Report 85-046). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

Kuperman, G. G. (1985). *Projective application of the Subjective Workload Assessment Technique to advanced helicopter crew system designs* (AFAMRL Technical Report 85-104). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Kuperman, G. G. (1986). *Crew system assessment working group, Volume II, composite mission scenario* (Report No. AFWAL-TR-85-3111). Wright-Patterson AFB, OH: Air Force Wright Aeronautical Laboratories. (DTIC No. B102514)

Kuperman, G. G. (1986). *Operator requirements for inverse Synthetic Aperture Radar* (Report No. AAMRL-TR-86-023). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. C040045)

Kuperman, G. G. (1990). Evaluation and integration of ATR crew aiding systems: A human factors approach. *Proceedings of the 1990 Automatic Target Recognizer System and Technology Conference* (GACIAC PR 90-04, pp. 473-479). Baltimore, MD: Guidance and Control Information Analysis Center.

Kuperman, G. G. (1992). *Information requirements analysis for transatmospheric vehicles* (Report No. AL-TR-1992-0082). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A261189)

Kuperman, G. G. (1992). *Operator interface assessment for the sensor fusion flight demonstration program* (Report No. AL-TR-1992-0117). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A260235)

Kuperman, G. G. (1994). Operator interface for a multi-sensor target acquisition system. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 2,* 638-645.

Kuperman, G. G., Bryant, M. L., & Clark, L. G. (1991). Man-machine interfaces for automatic target recognition systems. *Proceedings of the 4th National Symposium on Sensor Fusion, 1,* 635-642.

Kuperman, G. G., & Friedman, A. D. (1994). Prototyping for multisensor integration. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 2,* 726-733.

Kuperman, G. G., & Moss, R. W. (1986). *Dual role fighter crew system assessment working group: Summary of F-15E crew system assessment* (Report No. AFWAL-TR-85-3112). Wright-Patterson AFB, OH: Air Force Wright Aeronautical Laboratories. (DTIC No. B106798)

Kuperman, G. G., & Penrod, T. D. (1994). Evaluation of compressed Synthetic Aperture Radar imagery. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 1,* 319-326.

Kuperman, G. G., & Perez, W. A. (1988). A frame based mission decomposition model. *Proceedings of the Human Factors Society 32nd Annual Meeting, 1,* 135-139.

Kuperman, G. G., & Sobel, A. L. (1992). Design of the man-machine interface for an automatic target cuer system. *Proceedings of the Institute of Electrical and Electronic Engineers (IEEE), 2,* 691-697.

Kuperman, G. G., & Sobel, A. L. (1992). Information requirements analysis for NASP derived vehicles. *4th International Aerospace Planes Conference,* (Paper No. AIAA-92-5078).

Kuperman, G. G., & Sobel, A. L. (1992). Training systems for TAV operations. *1992 Society of Automotive Engineers Aerospace Atlantic Conference and Exposition,* (SAE Technical Paper Series 921042).

Kuperman, G. G., Spravka, J. J., Swonigan, T. T., & Sobel, A. (1993). *Counter mobile missile avionics demonstration* (Report No. AL-TR-1993-0049). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. C959997)

Kuperman, G. G., & Vikmanis, M. M. (1993). Air Force science and technology for precision strike: Human factors technology challenges. In R. Anderson *Proceedings of the Precision Strike Technology Symposium* (pp. 393-405). Fairfax, VA: The Cruise Missile Association.

Kuperman, G. G., & Wilson, D. L. (1986). An expert system approach to workload reduction. *Proceedings of the Human Factors Society 30th Annual Meeting, 1,* 702-706.

Kuperman, G. G., & Wilson, D. L. (1986). *Human-centered technology for advanced bomber crewstations* (Report No. AAMRL-TR-86-052). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B108960)

Kuperman, G. G., & Wilson, D. L. (1986). *Strategic Conventional Standoff Capability (SCSC): Radar operator workload study* (Report No. AAMRL-TR-86-024). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. C041410)

Kuperman, G. G., & Wilson, D. L. (1986). *Workload projection for relocatable target acquisition in a FLIR-equipped B-1B aircraft* (Report No. AAMRL-TR-86-028). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

Kuperman, G. G., & Wilson, D. L. (1987). *Abbreviated workload analysis for HAVE NAP* (Report No. AAMRL-TR-87-067). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. C042680)

Kuperman, G. G., & Wilson, D. L. (1988). The design of a tactical situation display. *Proceedings of the Human Factors Society 32nd Annual Meeting, 1*, 111-115.

Kuperman, G. G., & Wilson, D. L. (1990). *Demonstration of concept I avionics capability performance* (Report No. AAMRL-TR-90-059). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. C958373)

Kuperman, G. G., & Wilson, D. L. (1991). Objective and subjective assessment of image compression algorithms. *Society for Information Display International Symposium: Digest of Technical Papers, 22*, 627-640.

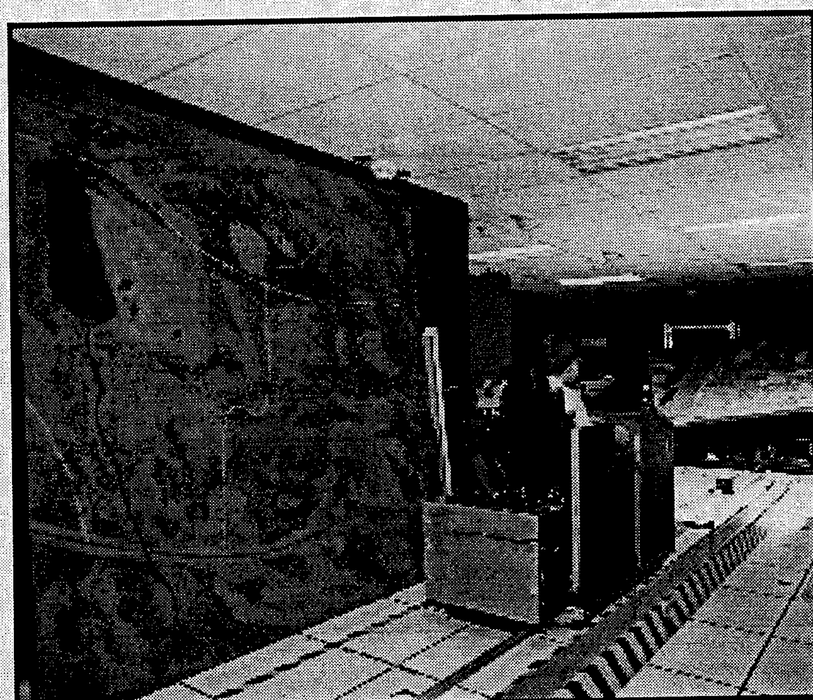
Kuperman, G. G., Wilson, D. L., & Crawford, R. L. (1989). Discriminability of color symbols through PLZT goggles. *Proceedings of the Human Factors Society 33rd Annual Meeting, 2*, 1378-1382.

Kuperman, G. G., Wilson, D. L., & Crawford, Y. R. (1989). *Wide dynamic range Synthetic Aperture Radar operator performance display study* (Report No. AAMRL-TR-89-020). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. C956972)

Kuperman, G. G., Wilson, D. L., & Davis, I. (1993). *High resolution radar demonstration program: Operator performance study* (Report No. AL-TR-1993-0032). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B176914)

Kuperman, G. G., Wilson, D. L., & Perez, W. A. (1988). *Relocatable target acquisition performance with simulated Synthetic Aperture Radar* (Report No. AAMRL-TR-88-025). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B177485)

Kuyk, T. K. (1988). *Visual depth recovery in humans* (Report No. AAMRL-TR-88-035). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A201278)



TERRAIN BOARD IN A STUDY OF DECEPTION TECHNIQUES FOR AIRBASE PROTECTION

An observer approaching a terrain board containing an airbase in a study of the effectiveness of deception using aircraft silhouette patterns on the ground. The work was done under Workunit 68930130, "Deceptive Technique Design and Evaluation" for the Subsystem/Support Equipment Special Project Office (ASD/ANG). The work was performed by Capt Robert Kang of AAMRL and Joseph Riegler, George E. Irvin, and Luan Katz of Systems Research Laboratories. AAMRL-TR-87-023 (1987)

TASK TIME ESTIMATOR

SSgt Wiley Wells (CFHA) was a subject for researcher Glenn Severt of UDRI in a 1994 study of how obstacles lengthen the time required to complete assembly tasks. These data were for the new Task Time Estimator for the CREW CHIEF computer model.

LaPuma, P. T., & Bridenbaugh, J. C. (1988). *Specifications and measurement procedures for aircraft transparencies* (Report No. AAMRL-TR-88-058). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A209396)

Leupp, D. G., Kelly, S., & Bridges, D. E. (1985). *A comparison of numeric data entry with touch-sensitive and conventional numeric keypads* (AFAMRL Technical Report 85-007). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory. (DTIC No. A153 276)

Levison, W. H., & Huggins, A. W. (1986). Modeling the effects of system delays and lags on tracking performance. *Proceedings of 22nd Annual Conference on Manual Control, 1*, 3-25.

Licht, D. M., Polzella, D. J., & Boff, K. R. (1991). *Human factors, ergonomics, and human factors engineering: An analysis of definitions* (Report No. 89-01). Wright-Patterson AFB, OH: CSERIAC Program Office.

Lincoln, J. E., & Boff, K. R. (1988). Making behavioral data useful for system design applications: Development of the engineering data compendium. *Proceedings of the Human Factors Society 32nd Annual Meeting, 2*, 1021-1025.

Lind, S., & Marshak, W. (1994). Cognitive engineering computer interfaces: Part I - Knowledge acquisition in the design process. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 2*, 753-755.

Lintern, G., & McMillan, G. R. (1993). Transfer for flight simulation. In R. A. Telfer (Ed.), *Aviation instruction and training* (pp. 130-162). Hants, England: Ashgate.

Llinas, J., Neal, J., & Kuperman, G. G. (1991). Systematic & practical views on intelligent interfacing for data fusion applications. *Proceedings of the AIAA Computers in Aerospace VIII Conference, 2*, 623-644.

Longinow, N. E. (1994). Predicting pilot look-angle with a radial basis function network. *IEEE Transactions on Systems, Man and Cybernetics*, 1511-1518.

Lovering, P. B., Noah, J. D., & Kuperman, G. G. (1988). *Infrared integration options for B-1B navigation and targeting* (Report No. AAMRL-TR-88-026). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B127695)

Lusk, S. L., Martin, C. D., Whiteley, J. D., & Johnson, W. V. (1990). Time delay compensation using peripheral visual cues in an aircraft simulator. *AIAA Flight Simulation Technologies Conference*, 63-70.

Marasco, P. L., & Dereniak, E. L. (1993). Uncooled infrared sensor performance. In B. F. Andresen, & F. D. Shepherd (Eds.), *Proceedings of the Society of Photo-Optical Instrumentation Engineers (SPIE): Infrared Technology XIX, 2020*, 363-378.

Maresh, J. L. (1991). Development of a real-time visual flight simulator for tactical operations research and development. *Proceedings of the Sixth International Symposium on Aviation Psychology*, 841-846.

BRAIN ELECTRICAL ACTIVITY
Brain electrical activity determines the pattern of active brain areas used to solve complex problems. This information is used to understand human cognition and will help measure operator state. (Task 718414)

Maresh, J. L., & Todd, R. E. (1989). Realtime graphic flight simulations using multiple mini-computers. In R. S. Jensen (Ed.), *Proceedings of the Fifth International Symposium on Aviation Psychology, 2,* 221-226.

Marshak, W., & Lind, S. (1994). Cognitive engineering computer interfaces: Part II - An objective design process. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 2,* 756-760.

Marshak, W. P. (1992). Temporal frequency spectrum for describing and modeling motion perception. *Proceedings of the Society of Photo-Optical Instrumentation Engineers (SPIE): Automatic Object Recognition II, 1700,* 476-480.

Marshak, W. P., Kang, R. N., Riegler, J. T., & Irvin, G. E. (1988). *Animated computer imagery in the evaluation of F-15 silhouette decoys* (Report No. AAMRL-TR-88-040). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A128216)

Marshak, W. P., Kuperman, G. G., Ramsey, E. G., & Wilson, D. L. (1987). Situational awareness in map displays. *Proceedings of the Human Factors Society 31st Annual Meeting, 1,* 533-535.

Marshak, W. P., Purvis, B. D., & Green, T. B. (1989). Integrating engineering with training simulation. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 2,* 754-756.

Martin, C. D. (1994). Application of a crew-centered cockpit design process and toolset. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 2,* 701-708.

Martin, E. A., McMillan, G. R., Warren, R., & Riccio, G. E. (1986). A program to investigate requirements for effective flight simulator displays. *Proceedings of the International Conference on Advances in Flight Simulation Visual and Motion Systems, The Royal Aeronautical Society.*

Martin, W. L. (1986). *An assessment of artificial intelligence and expert systems technology for application to the management of cockpit systems* (Report No. AAMRL-TR-86-040). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A175456)

Martin, W. L. (1992). Developing virtual cockpits. *AGARD Proceedings of the 63rd Avionics Panel Meeting: Advanced Aircraft Interfaces: The Machine Side of the Man-Machine Interface* (pp. 8-1 - 8-8). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-CP-521)

Masters, R. M., Horn, P. M., & Kulwicki, P. V. (1987). *Situation awareness and the CAT air superiority missions* (Report No. AAMRL-TR-87-005). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. C042570)

Mathews, C., & Johnson, D. (1992). *Combat air operations in the post-cold war world* (Report No. AL-TR-1992-0092). Wright-Patterson AFB, OH: Armstrong Laboratory.

Matin, E., & Boff, K. R. (1988). Information transfer rate with serial and simultaneous visual display formats. *Human Factors, 30*(2), 171-180.

Matin, E., & Boff, K. R. (1990). An adaptive (tracking) procedure for measuring visual search. *Perceptual and Motor Skills, 70,* 243-253.

Matin, E., & Boff, K. R. (1990). Human-machine interaction with serial visual displays. *Society for Information Display International Symposium: Digest of Technical Papers*, 257-260.

Matin, E., Boff, K. R., & Donovan, R. S. (1987). Raising control/display efficiency with rapid communication display technology. *Proceedings of the Human Factors Society 31st Annual Meeting, 1*, 258-262.

Matin, E., Shao, K. C., & Boff, K. R. (1993). Saccadic overload: Information processing time with and without saccades. *Perception and Psychophysics, 53*(4), 372-380.

May, J. G., Hartmann, E. E., Love, A. C., Cannon, M. W., & Ellis, G. S. (1987). The 'Face' validity of teller visual acuity cards. *Investigative Ophthalmology and Visual Science, 28*, 301.

McBride, D. J., & Brown, C. E. (1989). *Team performance in dynamic decision making: The importance of heuristics* (Report No. AAMRL-TR-89-010). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A209618)

McCarthy, J., Pantle, A., & Pinkus, A. (1994). Detection and discrimination performance with flicker gratings in peripheral vision. *Vision Research, 34*, 763-773.

McCloskey, K., Albery, W. B., Zehner, G., Bolia, S. D., Hundt, T. H., Martin, E. J., & Blackwell, S. (1992). *NASP re-entry profile: Effects of low-level +Gz on reaction time, keypad entry, and reach error* (Report No. AL-TR-1992-0130). Wright-Patterson AFB, OH: Armstrong Laboratory.

McCloskey, K. A., Morrow, M., & Perez, W. A. (1988). *The use of psychophysiological measures in the SABER laboratories: Phase I* (Report No. AAMRL-TR-88-052). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A206825)

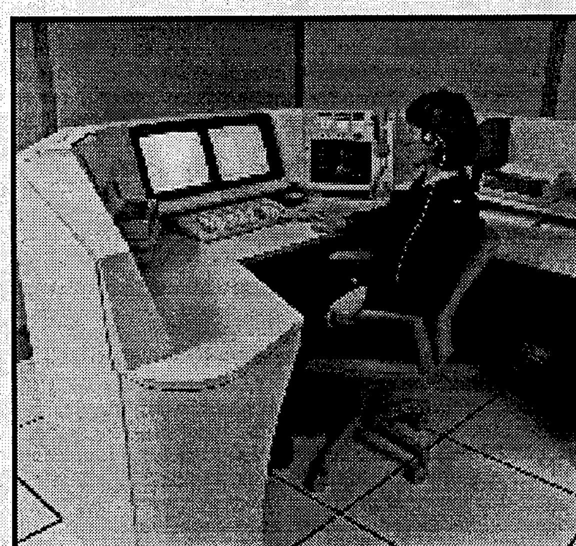
McCloskey, K. A., Morrow, M., & Perez, W. A. (1989). *Demonstration of physiological workload correlates in crew capability simulation* (Report No. AAMRL-TR-89-002). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A206824)

McDaniel, J. W. (in press). Function allocation and automation implementation in the U.S. Air Force. *Proceedings of the Workshop on Function Allocation, NATO DRG 8.*

McDaniel, J. W. (1986). Cockpit automation technology: A process for designing advanced aircraft systems. In D. J. Oborne (Ed.), *Contemporary Ergonomics: Proceedings of the Ergonomics Society: 1986 Annual Conference*, 143-147.

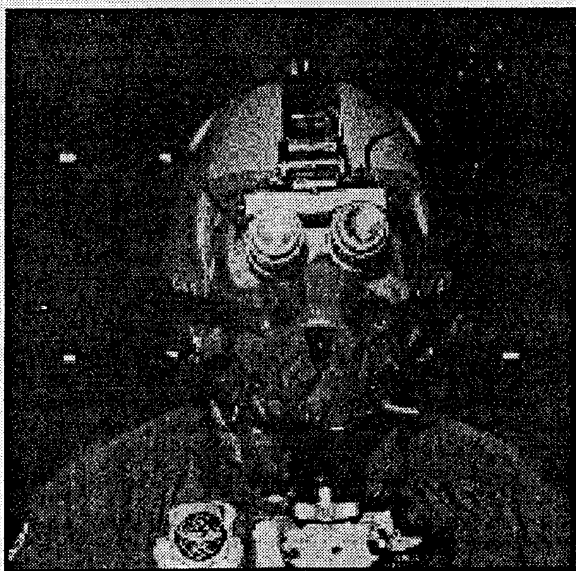
McDaniel, J. W. (1988). COMBIMAN and CREW CHIEF. In K. H. E. Kroemer, S. H. Snook, S. K. Meadows, & S. Deutsch (Eds.), *Ergonomic models of anthropometry human biomechanics and operator-equipment interfaces* (pp. 55-60). Washington, DC: National Academy Press.

McDaniel, J. W. (1988). CREW CHIEF: A computer graphics model of an aircraft maintenance technician. *Proceedings of the Sixth Annual Computer-Aided Engineering Program Users Meeting* (Report No. NWC TP 6910, pp. 601-603). China Lake, CA: Naval Weapons Center.



USING THE COPE WORKSTATION

2d Lt Suzanne Kelley using the Advanced Integrated Command, Control, Communication and Engineering Workstation of the C³ Operator Performance Engineering (COPE) task developed by the Human Engineering Division to study crew performance at command stations. This task was under the direction of Donald L. Monk and Michael D. McNeese. The picture was taken in 1986. (Project 7184)



PROTECTIVE HOOD AND NIGHT VISION GOGGLES

A chemical protective hood mask and aviator's night vision goggles used in a study to examine their compatibility. The work was conducted under Workunit 71841807 by Dr. Joseph T. Riegler of Logicon Technical Services, Inc. and Mary M. Donohue-Perry of the Human Engineering Division. AAMRL-TR-90-031 (1990)

McDaniel, J. W. (1988). Rules for fighter cockpit automation. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 3,* 831-838.

McDaniel, J. W. (1989). Modeling strength data for CREW CHIEF. In S. Griffin (Ed.), *Third Annual Workshop on Space Operations, Automation, and Robotics (SOAR '89)* (NASA CP-3059, pp. 143-148). Washington, DC: National Aeronautics and Space Administration.

McDaniel, J. W. (1989). Virtual mockup. *MANPRINT Bulletin, 4*(1), 4-7.

McDaniel, J. W. (1990). Models for ergonomic analysis and design COMBIMAN and CREW CHIEF. In W. Karwowski, A. M. Genaidy, & S. S. Asfour (Eds.), *Computer-aided ergonomics: A researcher's guide* (pp. 138-156). London: Taylor & Francis.

McDaniel, J. W. (1991). The development of computer models for ergonomic accommodation. In A. Mital, & W. Karwowski (Eds.), *Workspace, equipment and tool design* (pp. 29-66). Amsterdam: Elsevier.

McDaniel, J. W. (1994). Strength capabilities for operating aircraft controls. In F. Aghazadeh (Ed.), *Advances in Industrial Ergonomics and Safety VI* (pp. 705-712). Bristol, PA: Taylor & Francis.

McDaniel, J. W., & Askren, W. B. (1985). Computer-aided design models to support ergonomics. In I. D. Brown, R. Goldsmith, K. Coombes, & M. A. Sinclair (Eds.), *Proceedings of the 9th Congress of the International Ergonomics Association,* 442-444.

McDaniel, J. W., Helfter, J., Aume, N. M., Haddox, D. L., & Unger R. A. (1993). Available strength for transferring hospital patients between beds using a drawsheet. *Proceedings of the M. M. Ayoub Occupational Ergonomics Symposium* (pp. 1-7). Texas Tech University, TX: Institute for Ergonomics Research.

McDaniel, J. W., & Hofmann, M. A. (1990). Computer-aided ergonomics design tools. In H. R. Booher (Ed.), *MANPRINT: An approach to systems integration* (pp. 205-235). New York: Von Nostrand Reinhold.

McDaniel, J. W., & Robbins, C. G. (1992). The strength of women for activation of ejection seat controls. In S. Kumar (Ed.), *Advances in Industrial Ergonomics and Safety IV* (pp. 1275-1282). Washington, DC: Taylor & Francis.

McMillan, G. R. (1989). An overview of human performance models & potential applications to combat simulation. *Human behavior and performance as essential ingredients in realistic modeling of combat - MORIMOC II,* 55-68.

McMillan, G. R. (1991). Effects of visual system transport delay on pilot performance. *Visual Issues in Training and Simulation* (pp. 1-10). Williams AFB, AZ: Armstrong Laboratory.

McMillan, G. R., Beevis, D., Salas, E., Strub, M. H., Sutton, R., & Van Breda, L. (Eds.). (1989). *Applications of human performance models to system design.* New York: Plenum.

McMillan, G. R., Beevis, D., Stein, W., Strub, M. H., Salas, E., Sutton, R., & Reynolds, K. C. (1991). *A directory of human performance models for system design* (Report No. AC/243 (Panel 8) TR/1). Brussels, Belgium: NATO Defense Research Group.

McMillan, G. R., Cress, J. D., & Middendorf, M. S. (1990). Dynamic seat cuing with wide versus narrow field-of-view visual displays. *AIAA Flight Simulation Technologies Conference*, 53-62.

McMillan, G. R., Martin, E. A., Flach, J. M., & Riccio, G. E. (1985). Advanced dynamic seats: An alternative to platform motion? *Proceedings of the 7th Interservice/Industry Training Equipment Conference* (pp. 153-163). Arlington, VA: The American Defense Preparedness Association.

McNeese, M. D. (1986). A human factors perspective for developing intelligent cockpits. *IEEE Aerospace and Electronic Systems Magazine, 1*(9), 6-12.

McNeese, M. D. (1986). Human intelligence: A human factors approach for developing intelligent cockpits. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 3*, 941-948.

McNeese, M. D. (1989). *The boundaries of hemispheric processing in visual pattern recognition* (Report No. AAMRL-TR-89-042). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A217675)

McNeese, M. D. (1989). *Cerebral weevil: A machine learning model for hemispheric categorization of faces* (Report No. AAMRL-TR-89-045). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A218143)

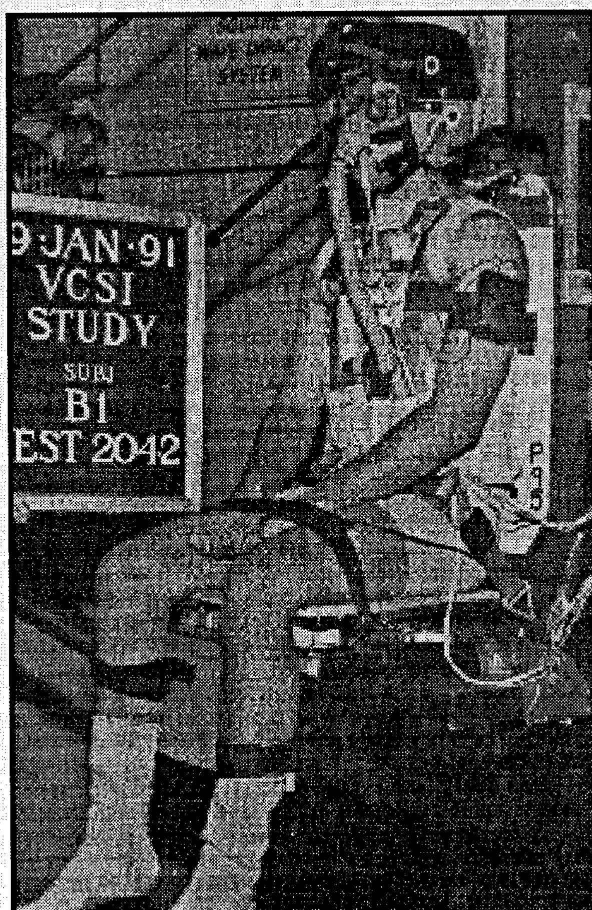
McNeese, M. D. (1989). *The role of chaos in hemispheric process and attention* (Report No. AAMRL-TR-89-043). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A217674)

McNeese, M. D. (1990). *Explorations in cooperative systems: Thinking collectively to learn, learning individually to think* (Report No. AAMRL-TR-90-004). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A218549)

McNeese, M. D. (1993). Analogical transfer in situated cooperative learning (Doctoral dissertation, Vanderbilt University, 1992). *Dissertation Abstracts International, 54*, 528B.

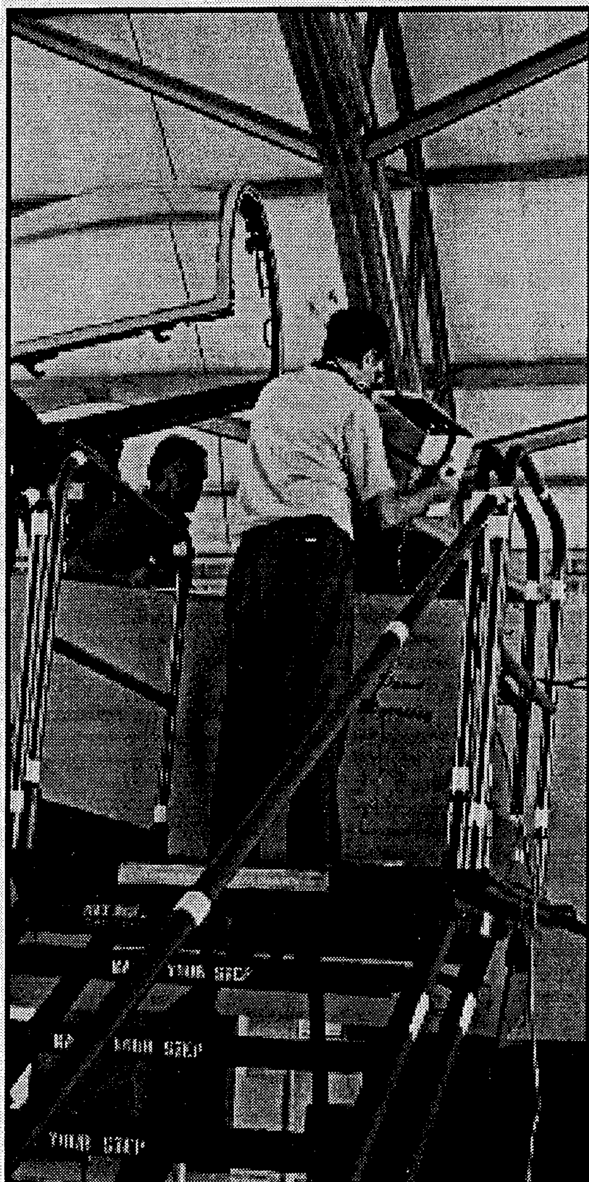
McNeese, M. D. (1993). Methods for sharing knowledge in engineering teams: Case studies involving user-centered design improvement. In L. Murray (Ed.), *Minutes of the 30th Meeting of the DOD Human Factors Engineering Technical Advisory Group* (pp. G-8 - G-9).

McNeese, M. D. (1993). *Putting knowledge to use: The acquisition and transfer of knowledge in situated problem solving environments* (Report No. AL/CF-TR-1993-0052). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A269746)



SIMULATING AIRCRAFT EJECTION FORCES FOR EFFECTS OF NIGHT-VISION GOGGLES

Seated test subject in a ground test vertical deceleration tower (VDF) for simulating forces occurring in ejection from aircraft in a study of integrated night vision goggles and a head tracking system. This is Volume 1 of a report prepared by R. Gunderman and J. Stiffler of Ball Systems Engineering Division for the Helmet Mounted Sensory Technology Project. AL-TR-1992-0087 (1992)



EVALUATING REFURBISHED AIRCRAFT WINDSCREENS
Lee Task (standing) and Bill Kama check out the condition of a refurbished F-15 windscreen at Eglin, AFB, Fla. (Workunit 71841802)

McNeese, M. D. (1994). A synopsis of naturalistic decision making: Implications for design. *CSERIAC Gateway, 5*(1), 6-7.

McNeese, M. D., & Brown, C. E. (1986). *Large group displays and team performance: An evaluation and projection of guidelines, research and technologies* (Report No. AAMRL-TR-86-035). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A255777)

McNeese, M. D., & Katsuyama, R. M. (1987). Neuropsychology in the cockpit: An analysis of configurational processing, hemispheric asymmetry, and masking disturbance. *Proceedings of the Fourth International Symposium on Aviation Psychology,* 202-208.

McNeese, M. D., & Katsuyama, R. M. (1989). *Lateral asymmetry in pattern recognition: Understanding the effects of familiarity, distinction, and perspective change* (Report No. AAMRL-TR-89-049). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A217739)

McNeese, M. D., & Katz, L. (1986). Legibility evaluation of a large screen display system under medium ambient illumination. *Society of Information Display International Symposium Digest,* 59-65.

McNeese, M. D., & Katz, L. (1987). Legibility evaluation of a large screen display system under medium ambient illumination. *Proceedings of the Society For Information Display, 28*(1), 59-65.

McNeese, M. D., & Zaff, B. S. (1991). Knowledge as design: A methodology for overcoming knowledge acquisition bottlenecks in intelligent interface design. *Proceedings of the Human Factors Society 35th Annual Meeting, 2,* 1181-1185.

McNeese, M. D., Zaff, B. S., & Brown, C. E. (1992). Computer supported collaborative work: A new agenda for human factors engineering. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 2,* 681-686.

McNeese, M. D., Zaff, B. S., Brown, C. E., Citera, M., & Selvaraj, J. A. (1993). Understanding the context of multidisciplinary design: A case for establishing ecological validity in the study of design problem solving. *Proceedings of the Human Factors and Ergonomics Society 37th Annual Meeting, 2,* 1082-1086.

McNeese, M. D., Zaff, B. S., Brown, C. E., Citera, M., & Wellens, A. R. (1992). The role of a group-centered approach in the development of computer-supported collaborative design technologies. *Proceedings of the Human Factors Society 36th Annual Meeting, 2,* 867-871.

McNeese, M. D., Zaff, B. S., Brown, C. E., Citera, M., & Whitaker, R. (in press). AKADAM: Eliciting user knowledge to support participatory ergonomics. *The International Journal of Industrial Ergonomics.*

McNeese, M. D., Zaff, B. S., Peio, K. J., Snyder, D. E., Duncan, J. C., & McFarren, M. R. (1990). *An advanced knowledge and design acquisition methodology: Application for the pilot's associate* (Report No. AAMRL-TR-90-060). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A233700)

Meindl, R. S., Zehner, G. F., & Hudson, J. A. (1993). *A multivariate anthropometric method for crew station design* (Report No. AL/CF-TR-1993-0054). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A270652)

Mellian, S. A., Ervin, C. A., & Robinette, K. M. (1991). *Sizing evaluation of navy women's uniforms* (Report No. AL-TR-1991-0116). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A249782)

Merhav, S. J., Lifshitz, S., & Kocian, D. F. (1994). *Advanced filtering methods in head teleoperated systems and helmet mounted displays* (Report No. AL/CF-SR-1994-0002). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A279446)

Merkel, H. S. (1988). *Investigation of a linear systems model for human visual detection and spatial frequency discrimination* (Report No. AAMRL-TR-88-061). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A209397)

Merkel, H. S., & Task, H. L. (1987). *Airborne direct-view optical system: Effects of target briefing on performance* (Report No. AAMRL-TR-87-026). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

Merkel, H. S., & Task, H. L. (1989). *An illustrated guide of optical characteristics of aircraft transparencies* (Report No. AAMRL-TR-89-015). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A214565)

Merkel, H. S., & Task, H. L. (1990). *Optical test of the space shuttle overhead windows* (Report No. AAMRL-TR-90-024). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A229919)

Merkel, H. S., Task, H. L., Whiteley, J. D., LaPuma, P. T., Pinkus, A. R., & Block, M. G. (1990). *The development of the Spaceborne Direct-View Optical System (SpaDVOS)* (Report No. AAMRL-TR-90-016). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B144518)

Merriken, M. S., Johnson, W. V., Cress, J. D., & Riccio, G. E. (1988). Time delay compensation using supplementary cues in aircraft simulator systems. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON)*, 295-303.

Merriken, M. S., Riccio, G. E., & Johnson, W. V. (1987). Temporal fidelity in aircraft simulator visual systems. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON)*, 50-54.

Merryman, R. F. K. (1994). Vista Sabre II: Integration of helmet-mounted tracker/display and high off-boresight missile seeker into F-15 aircraft. In R. J. Lewandowski, W. Stephens, & L. A. Haworth (Eds.), *Proceedings of the Society of Photo-Optical Instrumentation Engineers (SPIE): Helmet- and Head-Mounted Displays and Symbology Design Requirements, 2218*, 173-184.

Metzler, T. R. (1986). *Register of research in progress on mental workload* (Report No. AAMRL-TR-86-007). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A168210)

Middendorf, M. S., Fiorita, A. L., & McMillan, G. R. (1991). The effects of simulator transport delay on performance, workload, and control activity during low-level flight. *AIAA Flight Simulation Technologies Conference*, 412-426.

Middendorf, M. S., Johnson, W. V., Gilkey, M. J., & McClurg, T. D. (1989). A comprehensive collection of procedures for simulator verification. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON)*, 1-7.

Middendorf, M. S., Lusk, S. L., & Whiteley, J. D. (1990). Power spectral analysis to investigate the effects of simulator time delay on flight control activity. *AIAA Flight Simulation Technologies Conference*, 46-52.

Middleton, V. E., Chevalier, J. R., Evans, J. B., Felt, J. E., Hayes, T. R., McIntyre, R. T., Porter, C. D., Rayle, M. E., Rudofski, D., Shelef, S., Shew, R. L., & James, G. M. (1987). *Evaluation of individual protective equipment improvement objectives* (Report No. AAMRL-TR-87-002). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. C040557)

Miller, R. E., O'Neal, M. R., & Jackson, W. G. (1991). Vision detection of aircraft by USAF pilots: Spectacle wearers versus emmetropes [Abstract]. *Optometry and Vision Science, 68*(12,Suppl.), 181.

Miller, R. E., O'Neal, M. R., Woessner, W. M., Dennis, R. J., & Green, R. P. (1989). *The prevalence of spectacle wear and incidence of refractive error in USAF aircrew* (Report No. USAFSAM-TR-89-28). Brooks AFB, TX: USAF School of Aerospace Medicine. (DTIC No. AD-A220857)

Miller, R. E., Woessner, W. M., Dennis, R. J., O'Neal, M. R., & Green, R. P. (1990). Survey of spectacle wear and refractive error prevalence in USAF pilots and navigators. *Optometry and Vision Science, 67*(11), 833-839.

Mills, R. G. (1988). A user-assisted Generic Systems Analyst Workstation (GENSAW). *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON)*, 1065-1069.

Mills, R. G. (1988). A user-assisted Test & Evaluation Methodology Assistant Program (TEMAP). *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON)*, 1060-1064.

Mills, R. G. (1989). Crew-centered bomber mission model. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON)*, 765-771.

Miyamoto, A., & Wilson, G. F. (1990). Mapping of evoked magnetic field with visual stimulation: A secondary projection and processing system. *Aviation, Space and Environmental Medicine, 61*, 453.

Miyamoto, A., & Wilson, G. F. (1991). Mapping of evoked magnetic field with visual stimulation: A secondary projection and processing area. *Aviation, Space and Environmental Medicine, 62*(7), 638-647.

Moffitt, K., & Genco, L. V. (1985). *Criteria for a state-of-the-art vision test system* (AFAMRL Technical Report 85-004). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Monk, D. (1994). Computer Aided Systems Human Engineering: Performance Visualization System (CASHE: PVS) - An interactive, hypermedia design tool. *Proceedings of the Human Factors and Ergonomics Society 38th Annual Meeting, 2*, 948.

Monk, D. L., & Lincoln, J. E. (1994). User's Guide - computer aided systems human engineering: Performance visualization system. Wright-Patterson AFB, OH: Armstrong Laboratory.

Monk, D. L., Swierenga, S. J., & Lincoln, J. E. (1992). Developing behavioral phenomena test benches. *Proceedings of the Human Factors Society 36th Annual Meeting, 2*, 1106-1109.

Morris, N. M. (1987). Designing for user acceptance of design aids. In W. B. Rouse, & K. R. Boff (Eds.), *System design: Behavioral perspectives on designers, tools and organizations* (pp. 245-255). New York: North Holland.

Morris, N. M., & Rouse, W. B. (1986). *Adaptive aiding for human-computer control: Experimental studies of dynamic task allocation* (Report No. AAMRL-TR-86-005). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A166704)

Morris, N. M., Rouse, W. B., & Frey, P. R. (1985). *Adaptive aiding for symbiotic human-computer control: Conceptual model and experimental approach* (AFAMRL Technical Report 84-072). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Morton, K., & Swierenga, S. J. (1990). Developing effective coding schemes for an advanced visual display technology. *Proceedings of the 12th Biennial Psychology in the DOD Symposium*, 328-332.

Morton, K., & Zirkler, D. J. (1990). Using engineering models to compare paper and hypermedia-based displays of flight information. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON)*, 770-774.

Pilot's helmet helps interpret high-speed world

(New York Times—John Noble Wilford)

The pilot sits in the cockpit wearing a dark, bulging, bug-faced helmet that makes him look like the sinister Darth Vader in the movie "Star Wars." Projected on his visor is a synthesized panorama of the world he is flying over and into, the terrain below and the skies around. It is like having his head inside a marvelous, action-packed video game.

But it just may be the only way pilots will be able to handle the complex, high-speed aircraft of the future, especially in combat. Assisted by computers, tiny video tubes and other electronics, they will almost literally carry all their cockpit controls in the helmets they wear. The engineers who are developing this advanced technology call it a "virtual cockpit" or "supercockpit."

Missiles Streak Across Helmet Visor

On the helmet visor, the pilot sees moving green lines streak before his face, calling attention to antiaircraft missile fire. He applies pressure to the stick and makes a sharp evasive maneuver, away from the line of fire. The panorama, 120 degrees wide and 60 degrees high, changes accordingly. The pilot swings his head left or right and the view changes each time.

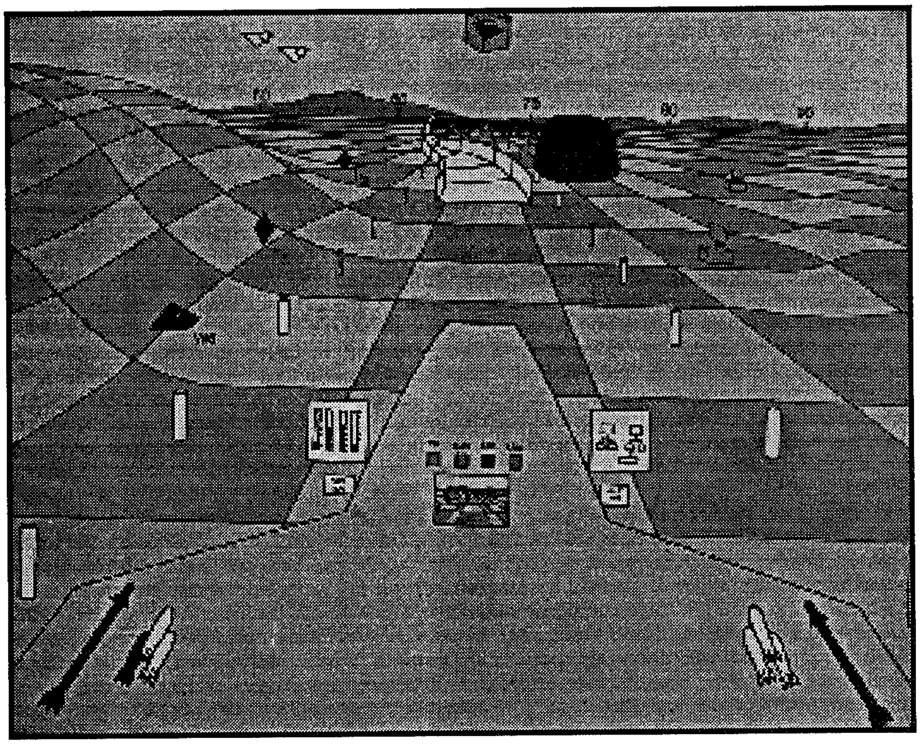
Superimposed on one corner of the panorama are numerical readouts of his altitude, velocity, and heading. There is a small square marked "status." He looks straight at the square, says "select" and sees projected there for a few moments symbols indicating the status of the plane's fuel, oil pressure and temperatures. The purpose is to know what he needs to know when he needs to know it, and not be overwhelmed by panels of gauges and dials.

Voice Commands Dispatch the "Bad Guys"

Ahead, above the outline of a distant mountain, appears a green triangle, topped by the number 9. Radar has detected a "bad guy" nine miles away. The pilot checks his weapons, calling by voice command for a symbolic display of the missiles available under the plane's wing. He selects one, by voice or by pressing a button, and the symbol for the selected missile flashes to remind the pilot it is ready.

The pilot wants a better view. "Zoom," he says, and an electronically synthesized voice echoes the command in confirmation. Instantly, the computer provides a closeup image of the terrain ahead, and of the bad guy. Or the pilot says "god's eye," and hears his command repeated. This, in effect, takes the pilot out of the aircraft and high above for a view of himself, the approaching enemy, and the entire theater of impending battle.

With a "normal" image put back before him, the pilot points the plane so the reticle of his gunsight rests squarely over the triangle marking the location of the enemy craft. He gives the command "lock on." Then, "fire." The missile streaks toward the target. A symbolic explosion of light fills the triangle in the image. An enemy is destroyed.



SYNTHESIZED PANORAMA PROJECTED ON VISOR OF FUTURE PILOT

Conceptual representation of the Super Cockpit in which the pilot has an abstracted pictorial view of the task, mission and threat environments. Night is turned into day, available weaponry are pictorially represented and accessed by alternative controls (voice, eye line-of-sight, or brain actuated). The pilot may navigate along a "highway in the sky." Threats are represented by their zones of lethality. (Workunit 71842601)

Morton, P. E., Tumey, D. M., Ingle, D. F., Downey, C. W., & Schnurer, J. H. (1991). Neural network classification of EEG data generated through use of the audio oddball paradigm. *Proceedings of the IEEE 17th Annual Northeast Bioengineering Conference*, 7-8.

Morton, P. E., & Wilson, G. F. (1988). Back propagation & EEG data. *Proceedings of the Fourth Annual Aerospace Applications of Artificial Intelligence Conference, 2*, 25-27.

Morton, P. E., & Wilson, G. F. (1992). *Back propagation and EEG Data* (Report No. AL-SR-1992-0026). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A279073)

Moss, R. W., Stollings, M. N., & Kuperman, G. G. (1986). *Crew system assessment working group, Volume IV, crew station assessment* (Report No. AFWAL-TR-85-3111). Wright-Patterson AFB, OH: Air Force Wright Aeronautical Laboratories. (DTIC No. B102516)

Nasman, V. T., Palmer, B., & Wilson, G. F. (1991). Effects of linguistic task difficulty on ERPs. *Psychophysiology, 28*(3A,Suppl.), S41.

Nelson, M. A., Sauer, D. W., & Kelly, S. (1987). *Human factors evaluation of the COPE prototype workstation* (Report No. AAMRL-TR-87-008). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

NEW SIZING METHODS

Ms. Kathleen Robinette is demonstrating the fit of one off-the-shelf size from the new sizing system she helped develop for the Navy women's uniform. This sizing system reduced the need for alterations from 75% to less than 1% without increasing the number of sizes. (Workunit 71840850)

Ochs, J. (1992). *Automated custom-fit production* (Report No. AL-SR-1992-0007). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B164883)

Oliver, C. G., & Wilson, G. F. (1989). A topographical comparison of visual and auditory discrimination processing [Abstract]. *Psychophysiology, 26*(4A,Suppl.), S47.

Oliver, C. G., & Wilson, G. F. (1991). Hemispheric asymmetry in parietal but not occipital MEG during a mental rotation task. *Psychophysiology, 28*(3A,Suppl.), S42.

Olson, J. L., Arbak, C. J., & Jauer, R. A. (1991). *Panoramic cockpit control and display system, Volume II: PCCADS 2000* (Report No. AL-TR-91-0017). Wright-Patterson AFB, OH: Armstrong Laboratory.

O'Neal, M. R. (1986). *In vivo assessment of mechanisms controlling corneal hydration* (Report No. AAMRL-TR-86-004). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

O'Neal, M. R. (1987). *Effect of refractive error change on pilot classification at the US Air Force Academy-Class of 1985* (Report No. AAMRL-TR-87-009). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

O'Neal, M. R. (1988). *Contact lenses: An encyclopedia article* (Report No. AAMRL-SR-88-001). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

O'Neal, M. R. (1988). Contact lenses. In J. G. Webster (Ed.), *Encyclopedia of medical devices and instrumentation* (Vol. 2, pp. 867-877). New York: John Wiley & Sons.

O'Neal, M. R. (1990). Effect of aircraft cabin altitude and humidity on oxygen tension under soft and hard gas-permeable contact lenses. *AGARD Conference Proceedings 492: Ocular Hazards in Flight and Remedial Measures* (pp. 23-1 - 23-9). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-CP-492)

O'Neal, M. R. (1991). Effect of aircraft cabin altitude and humidity on oxygen tension under soft and hard gas-permeable contact lenses. In P. E. Flattau (Ed.), *Considerations in Contact Lens Use Under Adverse Conditions: Proceedings of a Symposium* (pp. 106-118). Washington, DC: National Academy Press.

O'Neal, M. R., & Bonanno, J. A. (1993). Effects of contact lenses on corneal physiology. In M. Ruben, & M. Guillon (Eds.), *Contact lens practice* (pp. 969-989). London: Chapman and Hall Medical.

O'Neal, M. R., & Connon, T. R. (1986). *Refractive error change at the United States Air Force Academy - Class of 1985* (Report No. AAMRL-TR-86-026). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A175341)

O'Neal, M. R., & Miller, R. E. (1987). Further investigation of contrast sensitivity and visual acuity in pilot detection of aircraft. *Proceedings of the Human Factors Society 31st Annual Meeting, 2,* 1189-1193.

O'Neal, M. R., & Miller, R. E. (1987). A further investigation of visual acuity and contrast sensitivity in actual aircraft detection performance of pilots [Abstract]. *Investigative Ophthalmology and Visual Science, 28*(3,Suppl.), 301.

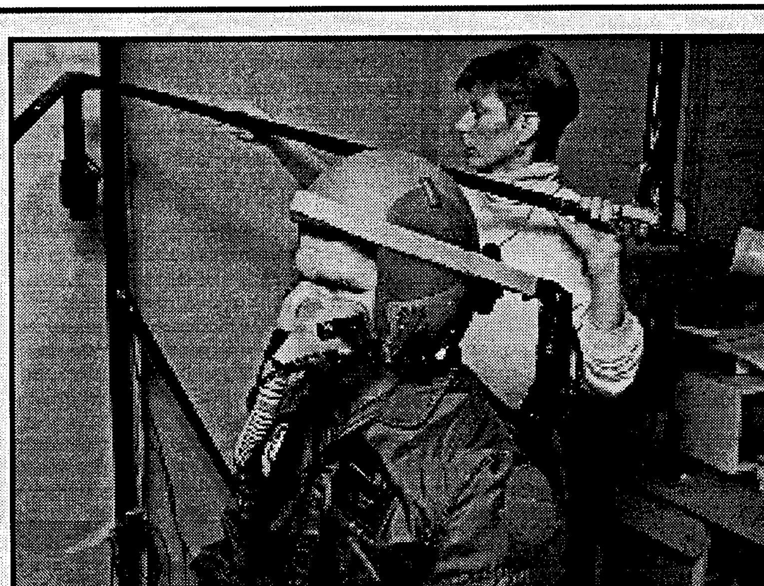
O'Neal, M. R., & Miller, R. E. (1988). *Further investigation of contrast sensitivity and visual acuity in pilot detection of aircraft* (Report No. AAMRL-TR-88-002). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A198434)

O'Neal, M. R., Miller, R. E., Woessner, W. M., Dennis, R. J., & Treadaway, D. K. (1989). Refractive error change since college graduation [Abstract]. *Investigative Ophthalmology and Visual Science, 30*(3,Suppl.), 141.

O'Neal, M. R., & Polse, K. A. (1986). Decreased endothelial pump function with aging. *Investigative Ophthalmology and Visual Science, 27*(10), 457-463.

O'Neal, M. R., Task, H. L., & Genco, L. V. (1990). Effect of microgravity on several visual functions during STS shuttle missions. *41st Congress of the International Astronautical Federation* (IAF/IAA-90-536, pp. 1-8). Paris: International Academy of Astronautics.

O'Neal, M. R., Task, H. L., & Genco, L. V. (1991). Visual function during microgravity on STS shuttle missions [Abstract]. *Optometry and Vision Science, 68*(12,Suppl.), 181.



MEASURING VISUAL OBSCURATION BY A HELMET AND OXYGEN MASK

Ms. Rebecca Unger is assisting TSgt Robert L. Stewart as he serves as an experimental subject in a study measuring the amount of visual obscuration caused by a helmet and oxygen mask. This work provided a small part of the data for the CREW CHIEF Man Model being developed by the Human Engineering Division. (1992) (Workunit 71840847)

Osgood, R. K., Geiselman, E. E., & Calhoun, C. S. (1991). Attitude maintenance using an off-boresight helmet-mounted virtual display. *AGARD Conference Proceedings 517: Helmet-Mounted Displays and Night Vision Goggles* (pp. 14-1 - 14-7). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-CP-517)

Osgood, R. K., Taylor, K., & McClurg, T. D. (1988). The dynamic seat as an angular motion cueing device. *Proceedings of the Human Factors Society 32nd Annual Meeting, 1*, 25-29.

Osgood, R. K., & Venturino, M. (1990). Information representations for aircraft attitude displays. *Proceedings of the Human Factors Society 34th Annual Meeting, 2*, 1542-1546.

Osgood, R. K., & Wells, M. J. (1991). The effect of field-of-view size on performance of a simulated air-to-ground night attack. *AGARD Conference Proceedings 517: Helmet-Mounted Displays and Night Vision Goggles,* (pp. 10-1 - 10-7). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-CP-517)

Osgood, S. S., Boff, K. R., & Donovan, R. S. (1988). Rapid communication display technology efficiency in a multi-task environment. *Proceedings of the Human Factors Society 32nd Annual Meeting, 2*, 1395-1399.

Owen, D. H., & Warren, R. (1987). Perception and control of self-motion: Implications for visual simulation of vehicular locomotion. In L. S. Mark, J. S. Warm, & R. L. Huston (Eds.), *Ergonomics and human factors: Recent research* (pp. 40-70). New York: Springer Verlag.

Another current project is space vision research, which the Air Force is working on with NASA. This consists of a series of tests being run on the space shuttle to determine the effects of microgravity on astronauts' vision. Astronauts have commented on changes in their vision in space, ranging from experiences of super vision to degraded near-vision.

—May 1985, "Human Engineering, Yesterday and Today," Civilian Employees Reporter

Palmer, B., Nasman, V. T., & Wilson, G. F. (1991). A comparison of referenced and reference-independent methodologies on ERP evaluation. *Psychophysiology, 28*(3A,Suppl.), S43.

Palmer, B., Nasman, V. T., & Wilson, G. F. (1994). Task decision difficulty: Effects of ERPs in a same-different letter classification task. *Biological Psychology, 38*, 199-214.

Palmer, B., Nasman, V. T., Wilson, G. F., & Gundel, A. (1992). *A brain evoked potential study of task difficulty using verbal memory and mental rotation tasks* (Report No. AL-TR-1992-0079). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A263871)

Pantle, A., McCarthy, J., & Pinkus, A. (1990). Detection of the spatial structure and motion of second-order stimuli [Abstract]. *Investigative Ophthalmology and Visual Science, 31*, 523.

Pantle, A., Pinkus, A., & McCarthy, J. E. (1991). The puzzling influence of high spatial frequencies on motion perception [Abstract]. *Investigative Ophthalmology and Visual Science, 32*, 892.

Pantle, A., Pinkus, A., & Strout, J. (1992). Motion signal interactions [Abstract]. *Investigative Ophthalmology and Visual Science, 33*, 973.

Papanicolaou, A., Wilson, G. F., Busch, C., DeRego, P., Orr, C., Davis, I. E., & Eisenberg, H. M. (1988). Hemispheric asymmetries in phonological processing assessed with probe evoked magnetic fields. *International Journal of Neuroscience, 39*, 275-281.

Patterson, R., & Martin, W. L. (1992). Human stereopsis. *Human Factors, 34*, 669-692.

Pearson, W. H. (1986). Work rate and ratio, II. Mathematical analysis for multi-resource model. *Psychometrika.*

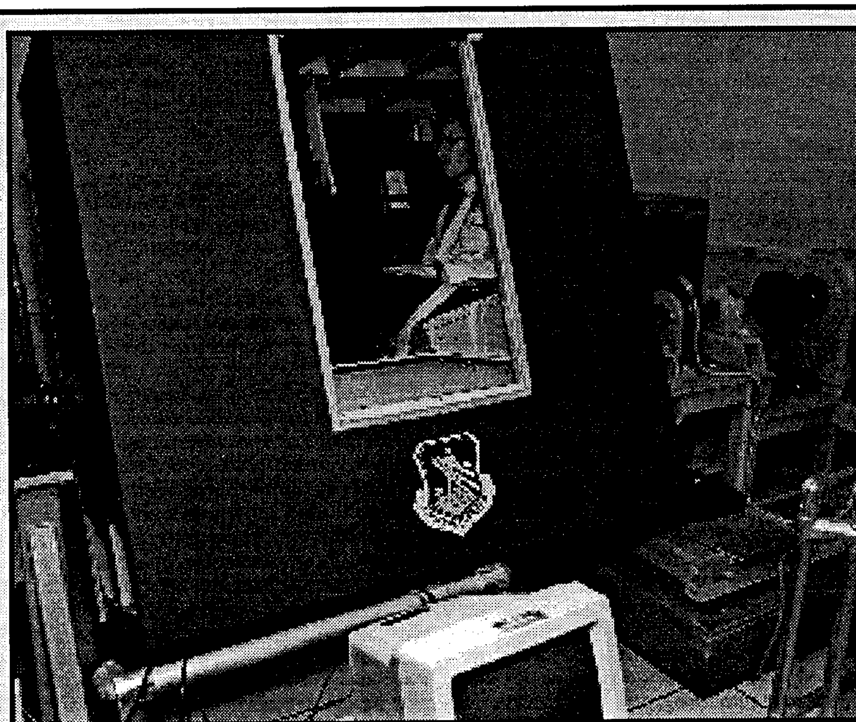
Peio, K. J., Crawford, R. L., & Kuperman, G. G. (1991). *Man-machine interface analyses for bomber flight management system* (Report No. AL-TR-1991-0018). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A245707)

Penrod, T. D., & Kuperman, G. G. (1993). *Image quality analysis of compressed Synthetic Aperture Radar* (Report No. AL/CF-TR-1993-0156). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A273399)

Perez, W. A., Masline, P. J., Ramsey, E. G., & Urban, K. E. (1987). *Unified tri-services cognitive performance assessment battery: Review and methodology* (Report No. AAMRL-TR-87-007). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A181697)

Pinkus, A. R. (1988). Night lighting and night vision goggle compatibility. *AGARD Lecture Series 156: Visual Effects in the High Performance Aircraft Cockpit* (pp. 7-1 -7-16). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-LS-156)

Pinkus, A. R. (1994). *The spatiotemporal characteristics of visual motion priming* (Report No. AL/CF-TR-1994-0084). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A284782)



BRAIN ACTUATED CONTROL OF MOTION SIMULATOR
Dr. Paul Morton self-regulates his brain electrical activity to control the cab's roll position in the Alternative Control Technology (ACT) Laboratory. Specific patterns of brain electroencephalographic (EEG) activity are identified and monitored. Using a biofeedback training method, operators learn to enhance or reduce brain electrical response strength. Noninvasive scalp electrodes are used to record changes, which are then translated into commands that control the operation of a physical device or computer program. (1994) (Task 718414)

Pinkus, A. R., & Task, H. L. (1988). Display system image quality. *AGARD Lecture Series 156: Visual Effects in the High Performance Aircraft Cockpit* (pp. 8-1 - 8-17). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-LS-156)

Pollack, R. B. (1990). *An investigation into techniques for landmarks identification on 3-D images of human subjects* (Report No. AAMRL-SR-90-0500). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A218614)

Pollack, R. B. (1993). *Neural network technologies* (Report No. AL-SR-1993-0002). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A262576)

Polzella, D. J., Masline, P. J., Amell, J. R., Perez, W. A., & Ramsey, E. G. (1987). The development of a spatial orientation task for inclusion in the Criterion Task Set (CTS). *Proceedings of the Human Factors Society 31st Annual Meeting, 1*, 394-397.

Polzella, D. J., & Reid, G. B. (1987). A multidimensional scaling analysis of Subjective Workload Assessment Technique (SWAT) ratings of the Criterion Task Set (CTS). *Proceedings of the Human Factors Society 31st Annual Meeting, 1*, 398-401.

Polzella, D. J., & Reid, G. B. (1989). Multidimensional scaling analysis of simulated air combat maneuvering performance data II: A follow-on study. In R. S. Jensen (Ed.), *Proceedings of the Fifth International Symposium on Aviation Psychology, 2*, 920-925.

Polzella, D. J., & Reid, G. B. (1991). A comparison of two statistical approaches to complex performance measurement. *Proceedings of the Sixth International Symposium on Aviation Psychology*, 841-846.

Porter, C. D., Jensen, J. G., & Chevalier, J. R. (1987). *Air base attack: Liquid agent challenge assessment—single versus multiple chemical munitions* (Report No. AAMRL-TR-87-025). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. C041709)

Post, D. L. (1985). Effects of color on CRT symbol legibility. *Society for Information Display International Symposium: Digest of Technical Papers, 16*, 196-199.

Post, D. L. (1986). U.S. Air Force color display issues. *Fifth Aerospace Behavioral Engineering Technology Conference Proceedings: Human Integration Technology: The Cornerstone for Enhancing Human Performance: Society of Automotive Engineers*, 227-247.

Post, D. L. (1988). Color specification and the CIE system of colorimetry. In K. R. Boff, & J. E. Lincoln (Eds.), *Engineering data compendium: Human perception and performance* (Vol. 1, pp. 374-381). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

Post, D. L. (1989). Basic approaches to color HMD. In L. M. Biberman (Ed.), *Proceedings of the Sensor Display Workshop: Vol. 1 Basic Principles* (IDA Document D-713, pp. 145-160). Alexandria, VA: Institute for Defense Analysis.

Post, D. L. (1992). Applied color-vision research. In H. Widdel, & D. L. Post (Eds.), *Color in electronic displays* (pp. 137-173). New York: Plenum.

Post, D. L. (1992). Colorimetric measurement, calibration, and characterization of self-luminous displays. In H. Widdel, & D. L. Post (Eds.), *Color in electronic displays* (pp. 299-312). New York: Plenum.

Post, D. L. (1993). A new color display for HMDs. *Insight, 15*(3), 8-10.

Post, D. L. (1994). Miniature color display for airborne HMDs. In R. J. Lewandowski, W. Stephens, & L. A. Haworth (Eds.), *Proceedings of the Society of Photo-Optical Instrumentation Engineers (SPIE): Helmet- and Head-Mounted Displays and Symbology Design Requirements, 2218*, 2-6.

Post, D. L. (1994). A new color display for HMDs. *Insight, 15*(3), 8-10.

Post, D. L., & Calhoun, C. S. (1987). An evaluation of methods for producing specific colors on CRTs. *Proceedings of the Human Factors Society 31st Annual Meeting, 2*, 1276-1280.

RESEARCH TO DEVELOP A HMD SYMBOLOGY STANDARD FOR TACTICAL APPLICATIONS

Dr. Robert K. Osgood, Task Manager of the Tactical Aircraft Cockpit Design and Evaluation Program (Task 718426) and member of the Visual Display Systems Branch, evaluating several candidate helmet-mounted display symbology sets in an operational mission environment using the Visually-Coupled Airborne Systems Simulator (VCASS). Osgood won the first Crew Systems Directorate Scientific Excellence Award in 1992 for his work in this research domain.

Post, D. L., & Calhoun, C. S. (1988). Color-name boundaries for equally bright stimuli on a CRT: Phase II. *Society for Information Display International Symposium: Digest of Technical Papers, 19,* 65-68.

Post, D. L., & Calhoun, C. S. (1989). Color-name boundaries for color coding [Insert]. *Applied Vision 1989 Technical Digest Series* (Vol. 16). Washington, DC: Optical Society of America.

Post, D. L., & Calhoun, C. S. (1989). Color-name boundaries for equally bright stimuli on a CRT: Phase III. *Society for Information Display International Symposium: Digest of Technical Papers, 20,* 284-287.

Post, D. L., & Calhoun, C. S. (1989). An evaluation of methods for producing desired colors on CRT monitors. *Color Research and Application, 14*(4), 172-186.

Post, D. L., & Greene, F. A. (1985). Color naming as a function of stimulus luminance, angular subtense, and practice. *Proceedings of the Human Factors Society 29th Annual Meeting 2,* 1070-1074.

Post, D. L., & Greene, F. A. (1986). Color-name boundaries for equally bright stimuli on a CRT: Phase I. *Society for Information Display International Symposium: Digest of Technical Papers, 17,* 70-73.

Post, D. L., & Lloyd, C. J. (1994). Color display gamuts and ambient illumination. *Displays, 15,* 39-43.

Post, D. L., Sarma, K. A., Trimmier, J. R., Heinze, W., Rogers, C. R., Ellis, R., Larson, B., & Franklin, H. (1994). A new color display for head-mounted use. *Journal of the Society for Information Display, 2,* 155-163.

Post, D. L., & Snyder, H. L. (1986). *Color contrast metrics for complex images* (Report No. HFL/ONR 86-2). Blacksburg, VA: Virginia Polytechnic Institute and State University.

Purvis, B. D. (1992). *An evaluation of B-1B pilot performance during simulated instrument approaches with and without status information* (Report No. AL-TR-1992-0088). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A263874)

Purvis, B. D., Craig, J. L., & Simons, J. C. (1988). *Night vision goggle head-up display for B-52 special operations* (Report No. AAMRL-TR-88-019). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B123860)

Purvis, B. D., Evers, K., Hoyland, C., Hill, J., & Brioida, M. (1988). *Visual simulation system computer program product specification* (Report No. AAMRL-TR-88-049). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B131762)

Purvis, B. D., Green, T. B., St. John, R. J., Reynolds, M. C., & Lovering, P. B. (1988). *B-1B Instrument Landing System (ILS) display format study* (Report No. AAMRL-TR-88-003). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B120771)

Purvis, B. D., Skelly, J. J., Simons, J. C., & Detro, S. (1988). *B-52 emergency war order survivability: Pilot effectiveness performance* (Report No. AAMRL-TR-88-032). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

Raab, F. H., & Brewster, C. C. (1988). *Magnetic-multipole technique for moveable scatterer compensation* (Report No. AAMRL-TR-88-054). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B133465)

Raab, F. H., Brewster, C. C., Stone, F. L., & Mackin, W. F. (1993). *Algorithms for magnetic helmet-mounted sight* (Report No. AL/CF-TR-1993-0077). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B176447)

Ramirez, T. L., Morthland, S. P., Soergel, C. D., Allread, G., & James, G. M. (1987). *Pretreatment side effects data base development* (Report No. AAMRL-TR-87-006). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. C040555)

Ramirez, T. L., Shew, R. L., Dembeck, C. M., Simons, J. C., Shogner, R. C., & James, G. M. (1987). *Seymour Johnson chemical warfare exercise field study and data analysis* (Report No. AAMRL-TR-87-003). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. C040556)

Ramirez, T. L., Shew, R. L., Felt, J. E., Rayle, M. E., & James, G. M. (1986). *A method for determining task time increase caused by the individual protective ensemble* (Report No. AAMRL-TR-86-036). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B108357)

Ratino, D. A., Repperger, D. W., Goodyear, C. D., Potor, G., & Rodriguez, L. E. (1988). Quantification of reaction time and time perception during space shuttle operations. *Aviation, Space and Environmental Medicine, 59*(3), 220-224.

Ratnaparkhi, M. V., Ratnaparkhi, M. M., & Robinette, K. M. (1992). Size and shape analysis techniques for design. *Applied Ergonomics, 23*(3), 181-185.

Reardon, K. A., Oliver, C. G., & Warren, R. (1987). Flight simulation training using standard and non-standard tasks. *Proceedings of the Human Factors Society 31st Annual Meeting, 2*, 1291-1295.

Reardon, K. A., & Warren, R. (1989). Effect of emergent detail on descent-rate estimations in flight simulators. In R. S. Jensen (Ed.), *Proceedings of the Fifth International Symposium on Aviation Psychology, 2*, 714-719.

Reeves, D. L., Stanny, R. R., Wilson, G. F., Herning, R. I., Pickworth, W., VanOrden, K. F., & Caldwell, J. A. (1991). *The OMPAT level 1 Neurophysiological Performance Assessment Battery (NPPAB)* (NAMRL Monograph No. 43). Pensacola, FL: Naval Aerospace Medical Research Laboratory.

Reid, G. B. (1985). The systematic development of a subjective measure of workload. *Proceedings of the 9th Congress of the International Ergonomics Association.*

Reid, G. B. (1988). The Subjective Workload Assessment Technique: A scaling procedure for measuring mental workload. In P. A. Hancock, & N. Meshkati (Eds.), *Human mental workload* (pp. 185-218). Amsterdam: North Holland.

Reid, G. B., & Haskell, B. E. (1986). A multidimensional scaling analysis of subjective work-load in low-time private pilots. *Aviation, Space and Environmental Medicine, 58*(12), 1230-1232.

Reid, G. B., Potter, S. S., & Bressler, J. R. (1989). *Subjective Workload Assessment Technique (SWAT): A user's guide* (Report No. AAMRL-TR-89-023). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A215405)

Reinhart, W. F., Glynn, C. D., Dye, C., Takahama, M., & Snyder, H. L. (1988). *The role of short-term memory in operator workload* (Report No. AAMRL-TR-88-024). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A200252)

Reynolds, H. M., Leurg, S., & Kincaid, V. (1985). *The position and mobility of the shoulder, spinal column and pelvis in seated subjects* (AFAMRL TR84-060). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Riccio, G. E., Cress, J. D., & Johnson, W. V. (1987). The effects of simulator delays on the acquisition of flight control skills: Control of heading and altitude. *Proceedings of the Human Factors Society 31st Annual Meeting, 2*, 1286-1290.

Rickles, W., Dunlosky, A., & Scott, B. (1991). *Anti-Satellite (ASAT) system timeline modeling* (Report No. AL-TR-1991-0092). Wright-Patterson AFB, OH: Armstrong Laboratory.

Rieck, A. M. (1993). *Virtual image voltmeter for aircraft maintenance technicians* (Report No. AL-TR-1993-0019). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B182457)

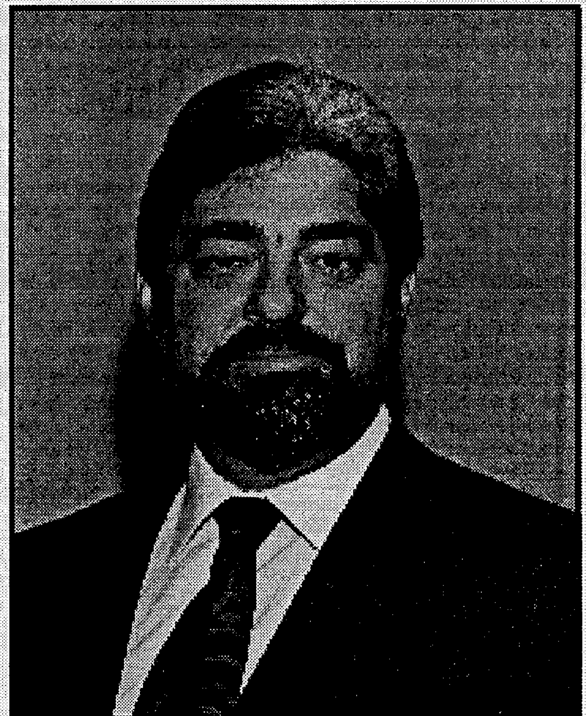
Rieck, A. M., & Dwyer, E. J. (1992). *Design of virtual image voltmeter device for maintenance technicians* (Report No. AL-SR-1992-0016). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B174365)

Riegler, J. T., & Donohue-Perry, M. M. (1990). *A field evaluation of the compatibility of the protective integrated hood mask with ANVIS night vision goggles* (Report No. AAMRL-TR-90-031). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A230237)

Riegler, J. T., Whiteley, J. D., Task, H. L., & Schueren, J. (1991). *The effect of signal-to-noise ratio on visual acuity through night vision goggles* (Report No. AL-TR-1991-0011). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A260579)

Kenneth R. Boff, PhD
Chief, Human Engineering Division

April 1991 to Present



The current Chief of the Human Engineering Division, Kenneth R. Boff earned a PhD in experimental psychology (Dynamic Visual Performance) from Columbia University in 1978. His personal research has focused on facilitating applications of human performance data and models in the design and evaluation of complex human system interfaces. More recently, he initiated the development of innovative data visualization techniques to enable computer-aided design, or CAD, representation of human performance data for crew system designers.

Dr. Boff actively consults and provides technical liaison with a broad range of government agencies, international working groups, universities, and professional societies and is founder and Technical Director of the Crew System Ergonomics Information Analysis Center (CSERIAC). He is the United States' Principal Investigator for the Joint US-French Super Cockpit Technologies Program, and an appointed member of the AGARD Aerospace Medical Panel, within which he chairs the Human Factors Committee.

Holder of a patent for Rapid Communication Display Technology, Dr. Boff has authored numerous articles, book chapters, and technical papers and is co-editor of *System Design* (1987), Senior Editor of the two-volume *Handbook of Perception and Human Performance* (1986) and the four-volume *Engineering Data Compendium: Human Perception and Performance* (1988).

Beginning in 1993 Dr. Boff served as the Joint Services Working Group Chairman leading the effort to establish the Human Systems Interface (HSI) technology area within Joint Directors of Laboratories (JDL) Reliance. In April 1994, the HSI Panel was formally approved within the Department of Defense and Dr. Boff was appointed Panel Chairman.

Rizzuto, A. P. (1988). *Diazepam and its effects on psychophysiological and behavioral measures of performance* (Report No. AAMRL-TR-87-074). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A198767)

Robinette, K. M. (1986). Anthropometric methods for improving protection. In R. L. Barker, & G. C. Coletta *Performance of Protective Clothing, ASTM STOP 900*, 569-580.

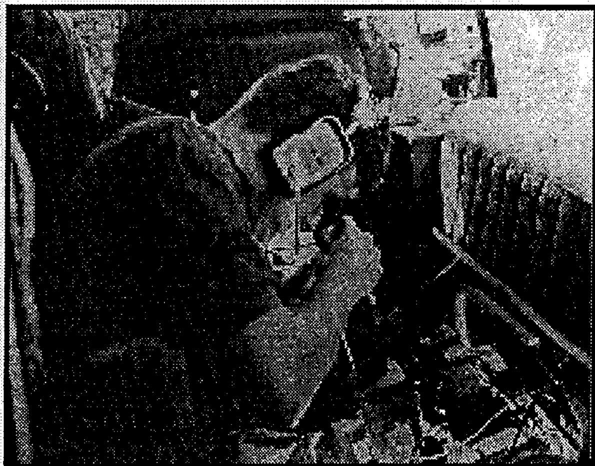
Robinette, K. M. (1986). Three-dimensional anthropometry-shaping the future. *Proceedings of the Human Factors Society 30th Annual Meeting, 1*, 205.

Robinette, K. M. (1992). Anthropometry for HMD design. *Proceedings of the Society of Photo-Optical Instrumentation Engineers (SPIE): Helmet-Mounted Displays III, 1695*, 138-145.

Robinette, K. M. (1993). Fit testing as a helmet development tool. *Proceedings of the Human Factors and Ergonomics Society 37th Annual Meeting, 1*, 69-73.

Robinette, K. M., & Annis, J. F. (1986). *A nine-size system for chemical defense gloves* (Report No. AAMRL-TR-86-029). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A173193)

Robinette, K. M., Ervin, C., & Zehner, G. F. (1986). *Dexterity testing of chemical defense gloves* (Report No. AAMRL-TR-86-021). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A173545)



USING AN OPTICAL VIEWING SYSTEM TO FIND GROUND TARGETS
An airborne observer visually searching for a ground target with a direct-view optical system in a target detection study measuring the usefulness to observers of briefing aids. The work was done under Program 62202F, Project 6893, Task 11, Workunit 02 by Lt Harold S. Merkel and Harry Lee Task. AAMRL-TR-87-026 (1987)

Robinette, K. M., Ervin, C. A., & Zehner, G. F. (1987). *Development of a standard dexterity test battery* (Report No. AAMRL-TR-87-034). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A188314)

Robinette, K. M., & Fowler, J. (1988). *An annotated bibliography of United States Air Force engineering anthropometry* (Report No. AAMRL TR-88-013). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A198345)

Robinette, K. M., Mellian, S. A., & Ervin, C. A. (1991). *Development of sizing systems for Navy women's uniforms* (Report No. AL-TR-1991-0117). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A250071)

Robinette, K. M., & Whitestone, J. J. (1992). *Methods for characterizing the human head for the design of helmets* (Report No. AL-TR-1992-0061). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A263875)

Robinette, K. M., & Whitestone, J. J. (1994). The need for improved anthropometric methods for the development of helmet systems. *Aviation, Space and Environmental Medicine, 65*(4).

Robinson, J. C., Robinette, K. M., & Zehner, G. F. (1988). *User's guide to accessing the anthropometric data base at the center for anthropometric research data* (Report No. AAMRL-TR-88-012). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A198771)

Robinson, J. C., Robinette, K. M., & Zehner, G. F. (1992). *User's guide to the anthropometric database at the computerized anthropometric research and design (CARD) laboratory second edition* (Report No. AL-TR-1992-0036). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A273002)

Rogers-Adams, B. M., Riegler, J. T., Irvin, G. E., & Dowler, M. G. (1988). *The effects of masking and shape disruptive patterns on the visual detection of ground parked aircraft* (Report No. AAMRL-TR-88-055). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B133684)

Rolek, E. P., & Snyder, D. E. (1986). *SAM Crew vulnerability to flightpath, ECM, and EOCM effects for acquisition to track transitions* (Report No. AAMRL-TR-86-053). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. C040714)

Rolek, E. P., & Snyder, D. E. (1988). *Demonstration of improved survivability through the use of strategies against Soviet SAM crews* (Report No. AAMRL-TR-88-031). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. C956305)

Ross, J., & Ervin, C. A. (1987). *Chemical defense flight glove ensemble evaluation* (Report No. AAMRL-TR-87-047). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A118401)

Ross, J. A. (in press). Multirate video sync stripper. *Electronic Design.*

Ross, J. A., & Kocian, D. (1994). *Hybrid video amplifier chip set for helmet-mounted visually coupled systems* (Report No. AL/CF-SR-1994-0031). Wright-Patterson AFB, OH: Armstrong Laboratory.

Ross, J. A., & Kocian, D. F. (1993). Hybrid video amplifier chip set for helmet-mounted visually coupled systems. *Society for Information Display International Symposium: Digest of Technical Papers, 24,* 437-440.

Rothey, J., Jones, M. W., Maute, K., Martinez. N., Krauskopf, P. J., Stump, W. J., Hardyal, S., Harper, W., Meeks, L., & McDaniel, J. W. (1990). *User's guide for CREW CHIEF: A computer graphics simulation of an aircraft maintenance Technician (Version 1.1 - CV CADDStation)* (Report No. AAMRL-TR-90-013). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

Rouse, W. B. (1986). A note on the nature of creativity in engineering: Implications for supporting system design. *Processing & Management, 22*(4).

Rouse, W. B. (1987). Designers, decision making, and decision support. In W. B. Rouse, & K. R. Boff (Eds.), *System design: Behavioral perspectives on designers, tools and organizations* (pp. 275-283). New York: North Holland.

Rouse, W. B. (1987). On meaningful menus for measurement: Disentangling evaluative issues in system design. *Information Processing and Management, 23*(6), 593-604.

Rouse, W. B., & Boff, K. R. (1987). Designers, tools, and environments: State of knowledge, unresolved issues and potential directions. In W. B. Rouse, & K. R. Boff (Eds.), *System design: Behavioral perspectives on designers, tools and organizations* (pp. 43-63). New York: North Holland.

Rouse, W. B., & Boff, K. R. (Eds.). (1987). *System design: Behavioral perspectives on designers, tools, and organizations.* New York: North Holland.

Rouse, W. B., & Boff, K. R. (1987). Workshop themes and issues: The psychology of system design. In W. B. Rouse, & K. R. Boff (Eds.), *System design: Behavioral perspectives on designers, tools and organizations* (pp. 7-17). New York: North Holland.

Rouse, W. B., & Cody, W. J. (1988). On the design of man-machine systems: Principles, practices, and prospects. *Automatica, 24*, 227-238.

Rouse, W. B., & Cody, W. J. (1989). Designers' criteria for choosing human performance models. In G. R. McMillan (Ed.), *Applications of human performance models to system design* (pp. 7-14). New York: Plenum.

Rouse, W. B., & Cody, W. J. (1989). Information systems for design support: An approach for establishing functional requirements. *Information and Decision Technologies, 15*(4), 281-289.

Rouse, W. B., & Cody, W. J. (1989). A theory-based approach to supporting design decision making. *Information and Decision Technologies, 15*(4), 291-306.

Rouse, W. B., Cody, W. J., & Boff, K. R. (1991). The human factors of system design: Understanding and enhancing the role of human factors engineering. *International Journal of Human Factors in Manufacturing, 1*, 87-104.

FUSION INTERFACE FOR TACTICAL ENVIRONMENTS (FITE)
Developed by Michael Haas in 1992, FITE utilized 25 personal computers to create a simulated, multi-aircraft air-to-air combat environment including aerodynamic, avionics, and weapons models. The crew station concepts and symbology developed in the FITE integrated helmet-mounted displays, 3-dimensional auditory display, head-up/head-down displays, and haptic displays. (Task 718419)

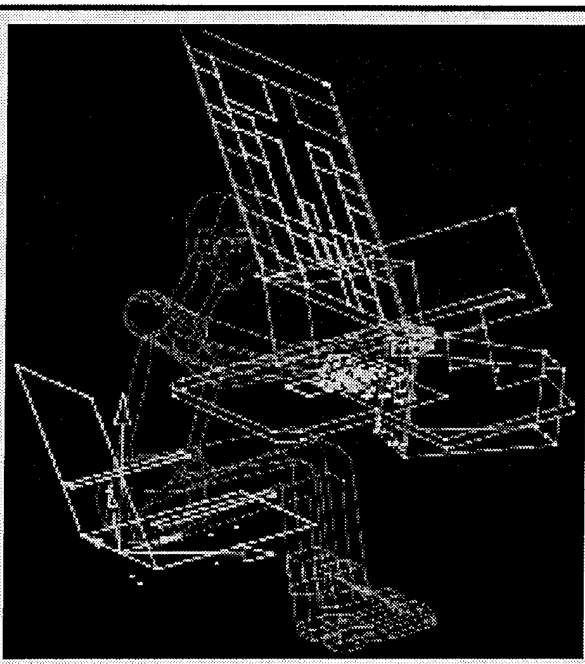
Rouse, W. B., Cody, W. J., Boff, K. R., & Frey, P. R. (1990). Information systems for supporting design of complex human-machine systems. In C. T. Leondes (Ed.), *Advances in aeronautical systems* (Vol. 38, pp. 41-100). San Diego: Academic Press.

Rouse, W. B., Cody, W. J., & Frey, P. R. (1992). Lessons learned in developing human-machine system design tools. *Information and Decision Technologies, 18*, 301-308.

Rueb, J., Vidulich, M. A., & Hassoun, J. (1992). Establishing workload acceptability: An evaluation of a proposed KC-135 cockpit redesign. *Proceedings of the Human Factors Society 36th Annual Meeting, 1*, 17-21.

Rueb, J. D., Vidulich, M. A., & Hassoun, J. A. (1994). Use of workload redlines: A KC-135 crew-reduction application. *The International Journal of Aviation Psychology, 4*, 47-64.

Samaras, G. M. (1992). *Development of a portable biopotential recorder for inflight acquisition* (Report No. AL-SR-1992-0024). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B184000)



COMBIMAN IN THE C-141
The COMBIMAN computer model was used in 1992 to evaluate physical accommodation of changes to a C-141 navigator's station. Analysis revealed the need to relocate a CRT display. (Workunit 71840847)

Sanderson, P. (1994). *MacSHAPA 1.0 software and user's manual.* Wright-Patterson AFB, OH: Armstrong Laboratory.

Sanderson, P. M., McNeese, M. D., & Zaff, B. S. (1994). Handling complex real-world data with two cognitive engineering tools: COGENT and MacSHAPA. *Behavior Research Methods, Instruments & Computers, 17*(2), 117-124.

Santoro, T. P., & Tsou, B. H. (1992). Trade-off between field-of-view and periscope scan rate in a target detection and bearing awareness study. *Society for Information Display International Symposium: Digest of Technical Papers, 23*, 298-300.

Sarma, K. A., Trimmier, J. R., Heinze, W., Rogers, C., Ellis, R., Larson, B., Franklin, H., & Post, D. L. (1993). Miniature color display. In J. Morreale (Ed.), *Society for Information Display International Symposium: Digest of Technical Papers, 24*, 1005-1008.

Schafer, E., & Bates, B. T. (1988). *Anthropometric comparisons between body measurements of men and women* (Report No. AAMRL-TR-88-020). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

Schafer, E., & Bates, B. T. (1988). *Anthropometric comparisons between face measurements of men and women* (Report No. AAMRL-TR-88-027). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

Schiffler, R. J., & Pinkus, A. R. (1986). Human factors research and development requirements for future aerospace cockpit systems. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 3*, 883-885.

Schiffler, R. J., & Pinkus, A. R. (1987). Human factors research and development requirements for future aerospace cockpit systems. *IEEE Aerospace and Electronic Systems Magazine, 2*(9), 2-4.

Schlegel, R. E., & Gilliland, K. (1990). *Evaluation of the Criterion Task Set - Part I Appendices A and B - Univariate summaries* (Report No. AAMRL-TR-90-008). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A225188)

Schlegel, R. E., & Gilliland, K. (1990). *Evaluation of the Criterion Task Set - Part I CTS performance and SWAT data - Baseline conditions* (Report No. AAMRL-TR-90-007). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A224331)

Schlegel, R. E., Gilliland, K., & Crabtree, M. S. (1992). *Development of the UTC-PAB normative database* (Report No. AL-TR-1992-0145). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A271319)

Schlegel, R. E., Gilliland, K., & Schlegel, B. (1987). Factor structure of the Criterion Task Set. *Proceedings of the Human Factors Society 31st Annual Meeting, 1*, 389-393.

Schnurer, J. H., Ingle, D. F., Downey, C. W., & Junker, A. M. (1992). *Brain actuated control of a roll axis tracking simulator* (Report No. AL-SR-1992-0025). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A275307)

Schnurer, J. H., Ingle, D. F., Downey, C. W., & Junker, A. M. (1994). *Real time frequency analysis methodology for evoked potential loop-closure* (Report No. AL/CF-SR-1994-0006). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A279149)

Schor, C., Gleason, G., Maxwell, J., & Lunn, R. (1993). Spatial aspects of vertical phoria adaptation. *Vision Research, 33*(1), 73-84.

Schor, C. M., Gleason, G. A., & Lunn, R. (1993). Interactions between short-term vertical phoria adaptation and nonconjugate adaptation of vertical pursuits. *Vision Research, 33*(1), 55-63.

Schuber, M., & O'Neal, M. R. (1988). Visual examination and performance during Head-Down-Tilt (HDT) induced upper body fluid shift [Abstract]. *Aviation, Space and Environmental Medicine, 59*(5), 486.

Self, H. C. (1986). *Optical tolerances for alignment and image differences for binocular helmet-mounted displays* (AAMRL-TR-86-019). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A174536)

Self, H. C. (1988). *Display size: A literature survey and a study with SLR imagery* (Report No. AAMRL-TR-88-001). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A200852)

Self, H. C. (1989). *Tutorial on the angular positions and velocities of ground objects viewed from aircraft* (Report No. AAMRL-TR-89-047). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A231283)

Self, H. C. (1992). *Optical displays: A tutorial on images and image formation* (Report No. AL-TR-1992-0178). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A266230)

Self, H. C. (1993). *Stress and the ergonomic design and evaluation of person-machine systems* (Report No. AL/CF-SR-1993-0008). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A275156)

Self, H. C. (1993). *A tutorial on exit pupils and eye rotation with virtual image optical displays* (Report No. AL-TR-1993-0010). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A262399)

Shepherd, D. S., Middleton, V. E., & Masak, J. R. (1988). *Post-attack hazard monitoring systems analysis, phase I : Chemical Detection, Identification, and Warning (CDIW) requirements* (AAMRL-TR-88-042). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. C043700)

Shmulovich, J. (1989). *Thin film phosphor development* (AAMRL-TR-89-004). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A272921)

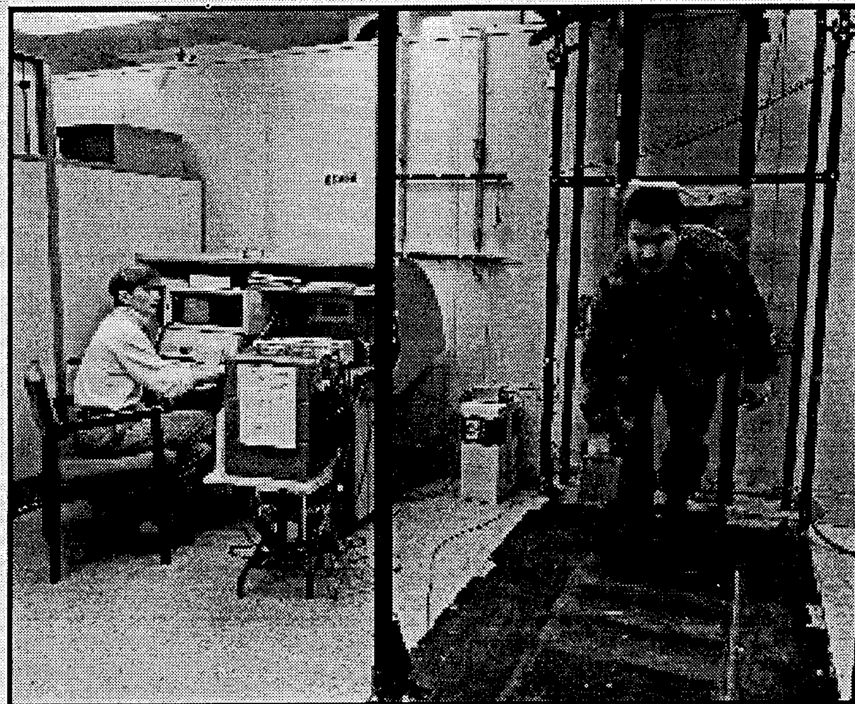
Shmulovich, J., & Kocian, D. F. (1989). Thin-film phosphors for miniature CRTs used in helmet-mounted displays. *Proceedings of the Society for Information Display, 30*(4), 297-302.

Simons, J. C., & Craig, J. L. (1989). Electroluminescent lights for formation flights. In R. S. Jensen (Ed.), *Proceedings of the Fifth International Symposium on Aviation Psychology, 1*, 251-256.

Simons, J. C., Kirtland, W. H., Malmstrom, F. V., Normand, K. A., Perez, W. A., Taylor, T. G., & Kuperman, G. G. (1987). *Strategic mission decomposition: I. Planning materials for advanced bomber simulation studies* (Report No. AAMRL-TR-87-016). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B112312)

POSTURE FOR LOAD CARRYING

SSgt Wiley Wells (CFHA) was a subject for researcher Becky Unger of UDRI in a 1994 study on posture for load carrying. Work posture is determined by a combination of factors, including the low ceiling and the amount of weight carried in the hands. (Task 718408)



Skelly, J. J. (1993). *Pacing visual attention: Temporal structure effects* (Report No. AL-TR-1993-0024). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A273859)

Skelly, J. J., Irvin, J., Perez, W., Simons, J., Houchard, J., Marshak, W. P., & Eller, M. (1993). *Sensor Preview Imagery (SPI): Target preview from off-board sensor for strike aircraft* (Report No. AL/CF-TR-1993-0129). Wright-Patterson AFB, OH: Armstrong Laboratory.

Skelly, J. J., Purvis, B. D., & Wilson, G. F. (1987). Fighter pilot performance during airborne & simulator mission: Physiological comparisons. *AGARD Conference Proceedings 432: Electric and Magnetic Activity of the Central Nervous System: Research and Clinical Applications in Aerospace Medicine* (pp. 23-1 - 23-16). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-CP-432)

Skelly, J. J., Roe, M. M., & Jones, M. R. (1994). *Temporal pacing in visual attention* (Report No. AL/CF-TR-1994-0087). Wright-Patterson AFB, OH: Armstrong Laboratory.

Slusher, W. M. (1985). *Instrument lighting levels and AN/AVS-6 usage* (AAMRL Technical Report 85-055). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A161 538)

Smith, J. L., Ayoub, M. M., & McDaniel, J. W. (1992). Manual materials handling capabilities in non-standard postures. *Ergonomics, 35*(7/8), 807-831.

Smith, S. L., Purvis, B., & Turner, S. (1994). Test Planning, Analysis and Evaluation System (Test PAES) a process and tool to evaluate cockpit design during flight test. *Proceedings of the Human Factors and Ergonomics Society 38th Annual Meeting, 2*, 942.

Snell, M. K., Flach, J. M., McMillan, G. R., & Warren, R. (1985). Tactual cuing can produce better performance than visual cuing. *Proceedings of the Third Symposium on Aviation Psychology*, 609-616.

Snyder, D. E., & McNeese, M. D. (1987). *Conflict resolution in cooperative systems* (Report No. AAMRL-TR-87-066). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A190351)

Snyder, D. E., McNeese, M. D., & Zaff, B. S. (1991). Identifying design requirements using integrated analysis structures. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 2*, 786-791.

Snyder, D. E., McNeese, M. D., Zaff, B. S., & Gomes, M. E. (1992). Knowledge acquisition of tactical air-to-ground mission information using concept mapping. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 2,* 668-674.

Snyder, D. E., Wellens, A. R., Brown, C. E., & McNeese, M. D. (1989). Three paradigms for the study of multi-person and human-machine interaction. *Proceedings of the IEEE Systems, Man, & Cybernetics Conference,* 840-841.

So, R. H. Y., & Griffin, M. J. (1993). *Effects of lags on human performance with head-coupled simulators* (Report No. AL/CF-TR-1993-0101). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A279577)

Sobel A. L., & Kuperman, G. G. (1993). Predictive human factors modeling in the flight environment. *Proceedings of the 41st International Congress of Aviation and Space Medicine,* 201-206.

Spravka, J. J., Crawford, R. L., & Kuperman, G. G. (1990). *A human factors review of the Synthetic Aperture Radar literature* (Report No. AAMRL-TR-90-022). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

Spravka, J. J., Gomes, M. E., & Lind, S. (1994). *Tools for automated knowledge engineering (TAKE) system evaluation methodology* (Report No. AL/CF-TR-1994-0113). Wright-Patterson AFB, OH: Armstrong Laboratory.

Spravka, J. J., Gomes, M. E., Lind, S., & Zehner, G. (1994). *A human factors evaluation of the MH-60 PAVE HAWK helicopter cockpit* (Report No. AL/CF-TR-1994-0056). Wright-Patterson AFB, OH: Armstrong Laboratory.

Spravka, J. J., Irvin, G. E., & Dowler, M. G. (1988). T-62 tank gunner tracking performance using a night vision display system of a function of background luminance, countermeasure power and countermeasure wavelength. *Proceedings of the 10th Annual Lasers on the Modern Battlefield Conference* (pp. 91-94).

Spravka, J. J., & Kuperman, G. G. (1992). *Preliminary human factors evaluation of ISECC* (Report AL-TR-1992-0069). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. C049863)

Spravka, J. J., Lind, S., & Gomes, M. E. (1994). *Exploratory applications of the tools for automated knowledge engineering (TAKE) to the crew-centered cockpit design process* (Report No. AL/CF-TR-1994-0145). Wright-Patterson AFB, OH: Armstrong Laboratory.

St. John, R. J., & Purvis, B. D. (1990). AIM SIGHT. *Proceedings of the Society of Photo-Optical Instrumentation Engineers (SPIE): Cockpit Displays and Visual Simulation, 1289,* 63-67.

Stengel, J. D. (1994). *Systems engineering design and technical analysis for Strategic Avionics Crew Station Design Evaluation Facility* (AL/CF-TR-1994-0074). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A286239)

Stephens, B. R., Cannon, M. W., Ellis, D., & Monachino, L. (1994). Identification of complex gratings as a function of contrast and spatial frequency [Abstract]. *Investigative Ophthalmology and Visual Science, 35*(4), 2006.

Stephens, B. R., Cannon, M. W., & Fullenkamp, S. C. (1992). Perception of image contrast and image profile of low frequency gratings [Abstract]. *Investigative Ophthalmology and Visual Science, 33,* 1350.

Stern, J. A., Dunham, D. N., & Goldstein, R. (1988). *An evaluation of electrooculographic, head movement and steady state evoked response measures of workload in flight simulation* (AAMRL-TR-88-036). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A236505)

Stiffler, J. A., & Wiley, L. (1992). I-NIGHTS and beyond. In T. M. Lippert (Ed.), *Proceedings of the Society of Photo-Optical Instrumentation Engineers (SPIE): Helmet-Mounted Displays III, 1695,* 13-20.

Stoffregen, T. A., & Riccio, G. E. (1988). An ecological theory of orientation and the vestibular system. *Psychological Review, 95*(1), 3-14.

Storey, B. A., Osgood, R. K., & Schueren, J. C. (1994). Aircraft/mission requirements approach for helmet-mounted display decisions. In R. J. Lewandowski, W. Stephens, & L. A. Haworth (Eds.), *Proceedings of the Society of Photo-Optical Instrumentation Engineers (SPIE): Helmet- and Head-Mounted Displays and Symbology Design Requirements, 2218,* 238-247.

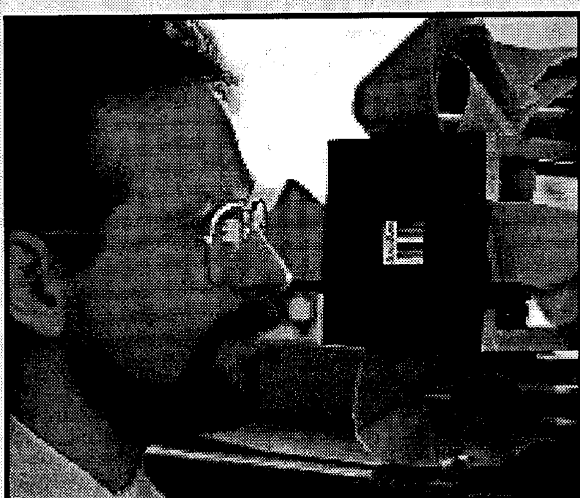
Storey, B. A., Rountree, M. E., Kulwicki, P. V., & Cohen, J. B. (1994). Development of a process for cockpit design. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 2,* 688-695.

Strayer, D. L., & Kramer, A. F. (1988). *The retrieval of information from secondary memory: A review and new findings* (Report No. AAMRL-TR-88-041). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A222760)

Swierenga, S. J., Boff, K. R., & Donovan, R. S. (1991). Coding techniques for rapid communication displays. *Proceedings of the Sixth International Symposium on Aviation Psychology, 1,* 204-209.

Swierenga, S. J., Boff, K. R., & Donovan, R. S. (1991). Effectiveness of coding schemes in rapid communication displays. *Proceedings of the Human Factors Society 35th Annual Meeting, 2,* 1522-1526.

Swierenga, S. J., Monk, D. L., & Brown, C. E. (1992). Human performance data visualization for system design teams. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 2,* 675-680.



COLOR HELMET-MOUNTED DISPLAYS
Dr. David L. Post examines the Miniature Color Display (MCD), developed in 1993 by the Color Display Laboratory for airborne helmet-mounted displays. This breakthrough device has laser-printer resolution and 100 times more light than a TV. The technology has been transitioned to the Advanced Research Projects Agency for advanced development. (Workunit 71841149)

Swierenga, S. J., Morton, K., & Boff, K. R. (1990). Issues concerning the use of human engineering information: The system designers' perspective. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON),* 881-885.

Task, H. L. (1985). *Bias and misinformation in technical and managerial communications* (Report No. AAMRL-TR-85-054). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory.

Task, H. L. (1985). Glare and reflections in day and night flying. *Aircraft Attitude Awareness Workshop* (pp. 2-12-1 - 2-12-26). Wright-Patterson AFB, OH: Flight Dynamics Laboratory.

Task, H. L. (1988). Vision through aircraft transparencies. *AGARD Lecture Series 156: Visual Effects in the High Performance Aircraft Cockpit* (pp. 4-1 - 4-14). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-LS-156)

Task, H. L. (1989). Vision through aircraft transparencies. In S. A. Marolo (Ed.), *Conference on Aerospace Transparent Materials and Enclosures* (WRDC-TR-89-4044, Vol. 2, pp. 1047-1071). Wright-Patterson AFB, OH: Wright Research and Development Center.

Task, H. L. (1991). Optical and visual considerations in the specification and design of helmet-mounted displays. *Society for Information Display International Symposium: Digest of Technical Papers, 22,* 297-300.

Task, H. L. (1992). Cockpit/NVG visual integration issues. *AGARD Lecture Series 187: Visual Problems in Night Operations* (pp. 8-1 - 8-6). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-LS-187)

Task, H. L. (1992). Night vision devices and characteristics. *AGARD Lecture Series 187: Visual Problems in Night Operations* (pp. 7-1 - 7-8). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-LS-187)

Task, H. L., & Genco, L. V. (1985). *The measurement of aircraft windscreen haze and its effect on visual performance* (Report No. AFAMRL-TR-85-017). Wright-Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

WINDSCREEN RESEARCH

An F-111 windscreen undergoes optical distortion analysis in preparation for a visual assessment study. (Task 718418)

Task, H. L., & Genco, L. V. (1987). Effects of short-term space flight on several visual functions. In M. W. Bungo, T. M. Bagian, M. A. Bowman, & B. M. Levitan (Eds.), *Results of the life sciences DSOs conducted aboard the space shuttle 1981-1986* (pp. 173-178). Johnson Space Center, TX: National Aeronautics and Space Administration.

Task, H. L., Hartman, R. T., Marasco, P. L., & Zobel, A. R. (1993). *Methods for measuring characteristics of night vision goggles* (Report No. AL/CF-TR-1993-0177). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A277046)

Task, H. L., Hartman, R. T., & Zobel, A. R. (1990). New methods for night vision goggle test and evaluation. *Proceedings of Test Technology Symposium III* (pp. 259-268). Aberdeen Proving Ground, MD: U.S. Army Test and Evaluation Command.

Task, H. L., & Merkel, H. S. (1989). *A new method for measuring the transmissivity of aircraft transparencies* (Report No. AAMRL-TR-89-044). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A216953)

Task, H. L., & Pinkus, A. R. (1987). Contrast sensitivity and target recognition performance: A lack of correlation. *Society for Information Display International Symposium: Digest of Technical Papers, 18,* 127-129.

Task, H. L., & Pinkus, A. R. (1987). The role of the contrast sensitivity function in display image quality metrics. *Electronic Imaging '87: International Electronic Imaging Exposition and Conference, 1,* 161-166.

Teall, T. A. (1992). *Pilot-centric design methodology and concepts program: Technical analytical study program* (Report No. AL-SR-1992-0027). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A276491)

Tolcott, M. A., Lehner, P. E., & Mullen, T. M. (1989). *User interaction with self-learning systems* (Report No. AAMRL-TR-89-029). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A214280)

Toms, M. L., & Kuperman, G. G. (1992). *Sensor fusion: A human factors perspective* (Report No. AL-TR-1991-0152). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B165851)

Tsang, P. S., & Vidulich, M. A. (1987). Timesharing visual and auditory tracking tasks. *Proceedings of the Human Factors Society 31st Annual Meeting, 1,* 253-257.

Tsang, P. S., & Vidulich, M. A. (1989). Cognitive demands of automation in aviation. In R. S. Jensen (Ed.), *Aviation psychology* (pp. 66-95). Essex, Great Britain: Gower.

Tsang, P. S., & Vidulich, M. A. (1994). The roles of immediacy and redundancy in relative subjective workload assessment. In W. C. Howell (Ed.), *Human Factors, 36*(3), 503-513.

Tsou, B. H. (1989). Visual psychophysical considerations in the design of binocular helmet-mounted displays. In L. M. Biberman (Ed.), *Proceedings of the Sensor Display Workshop: Vol. 2 Display Technology* (IDA Document D-713, pp. 45-74). Alexandria, VA: Institute for Defense Analysis.

Tsou, B. H. (1993). System design considerations for a visually-coupled system. In S. R. Robinson (Ed.), *The infrared and electro-optics systems handbook: Vol. 8. Emerging systems and technologies* (pp. 515-536). Bellingham, WA: SPIE Optical Engineering Press.

Tsou, B. H., Allen, D. M., & Walker, J. L. (1987). Dynamic distortion correction for dome display. *The 1987 IMAGE Conference IV* (pp. 129-139). Williams AFB, AZ: Air Force Human Resources Laboratory.

Tsou, B. H., & Grigsby, S. S. (1993). Visual field-of-view: A design factor for binocular helmet-mounted displays. *Proceedings of the 1993 Meeting of the IRIS Specialty Group on Passive Sensors* (IRIAC Report No. 213400-169-X(II), Vol. 2, pp. 107-109). Ann Arbor, MI: Infrared Information Analysis Center.

Tsou, B. H., & Rogers-Adams, B. M. (1990). The effect of aspect ratio on helmet mounted display field of view. *Report of the 30th Meeting of Air Standardization Coordination Committee (ASCC) Working Party 61: Aerospace Medical and Life Support Systems Symposium: Aeromedical Aspects of Vision* (Vol. 4, pp. 136-146). Toronto: Defence and Civil Institute of Environmental Medicine.

Tsou, B. H., Rogers-Adams, B. M., & Beard, M. (1991). Distance perception and ocular accommodation in helmet-mounted displays. *Society for Information Display International Symposium: Digest of Technical Papers, 22*, 313.

Tsou, B. H., Rogers-Adams, B. M., & Goodyear, C. D. (1991). The evaluation of partial binocular overlap on car maneuverability: A pilot study. In K. Krishen (Ed.), *Fifth Annual Workshop on Space Operations, Applications, and Research (SOAR '91)* (NASA CP-3127, Vol. 2, pp. 562-568). Washington, DC: National Aeronautics and Space Administration.

"Some of my most satisfying work was the refinement of the brain stem evoked response as a screening method for detecting hearing deficits in young children. A pediatrician and a neurologist at the Base Hospital picked up on this and used to send kids—and later adults—over to us at the lab for testing. At one time we had 3 to 4 patients a day being transported over there; we must have tested a total of 200 to 300 people. Real medical decisions were being made on the basis of this test. It's interesting that most audiologists at that time were negative about the use of the evoked brain stem technique. Well, I just had my hearing tested at the Base Hospital recently and asked if they ever do brainstem evoked response. The audiologist said, 'Oh yes, that's our standard procedure.'"

— Robert O'Donnell, Chief
Workload and Ergonomics Branch
Human Engineering Division

"One of the last efforts I was involved with here was dramatically different from any other I had done, but was very enjoyable. It had to do with the design of checkout counters for the commissary system. Since checkout personnel come in all sizes, there was a need to develop a counter which was either a good compromise height for everyone, or to come up with an adjustable version, so that repetitive motion injuries could be avoided."

— Steve Heckart
Applications Human Engineer
Human Engineering Division

Tumey, D., Morton, P., Ingle, D., Downey, C., & Schnurer, J. H. (1992). *Neural network classification of EEG using chaotic preprocessing and phase space reconstruction* (Report No. AL-SR-1992-0021). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A279098)

Tumey, D. M., Morton, P. E., Ingle, D. F., Downey, C. W., & Schnurer, J. H. (1991). Neural network classification of EEG using chaotic preprocessing and phase space reconstruction. *Proceedings of the IEEE 17th Annual Northeast Bioengineering Conference*, 51-52.

Urban, K. E., Irvin, G. E., & Dowler, M. G. (1989). Detection of aircraft targets during laser-induced transient visual field loss: Effects of canopies and laser protective visors. *Proceedings of the Seventh DOD Conference of Directed Energy Weapons: Vulnerability, Survivability and Effects* (pp. 383-388).

Valencia, G., & Agnew, J. R. (1990). Evaluation of a directional audio display synthesizer. *Proceedings of the Human Factors Society 34th Annual Meeting, 1*, 6-10.

Valencia, G., & Calhoun, G. L. (1989). *Headphone localization with a single sound transducer and moveable manikin head* (Report No. AAMRL-TR-89-005). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B133510)

Valencia, G., Calhoun, G. L., Ericson, M. A., & Agnew, J. R. (1990). *Localization performance with synthesized directional audio* (Report No. AAMRL-TR-90-025). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A230316)

Valencia, G., Ericson, M. A., & Agnew, J. R. (1990). A comparison of localization performance with two auditory cue synthesizers. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON)*, 749-754.

Vargo, C. G., Brown, C. E., & Swierenga, S. J. (1992). An evaluation of computer-supported backtracking in a hierarchical database. *Proceedings of the Human Factors Society 36th Annual Meeting, 1*, 356-360.

Venturino, M., & Post, D. L. (Eds.). (1992). Visual displays [Special issue]. *Human Factors, 34*, 509-634.

Venturino, M. R. (1987). Capacity limitations in human information processing: Theory & applications. *Proceedings of the Human Factors Society 31st Annual Meeting, 1*, 672-673.

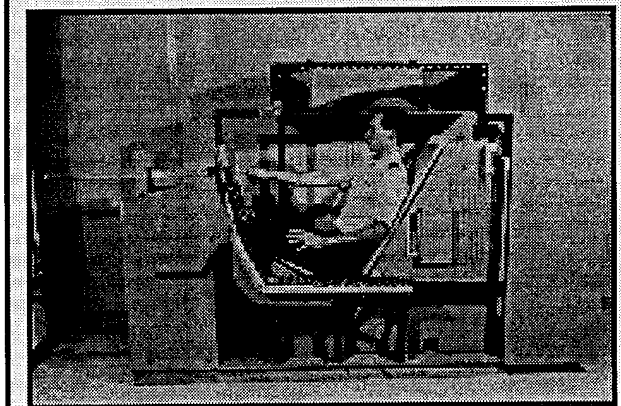
Venturino, M. R. (1987). Concurrent memory search: The roles of automaticity and multiple resources [Abstract]. *Proceedings and Abstracts of the Annual Meeting of the Eastern Psychological Association*, 58.

Venturino, M. R. (1988). Timesharing memory searches: The roles of automaticity & multiple resources [Abstract]. *Proceedings and Abstracts of the Annual Meeting of the Eastern Psychological Association*, 23.

Venturino, M. R. (1989). Performance-based measures of merit for tactical situation awareness. *AGARD Conference Proceedings 478: Situation Awareness in Aerospace Operations* (pp. 4-1 - 4-5). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-CP-478)

Venturino, M. R. (1991). Timesharing memory searches: The roles of automatic processing & multiple resources theories. *Journal of Experimental Psychology: Learning, Memory & Cognition, 17*(3), 677-695.

Venturino, M. R., & Geiselman, E. E. (1992). Quantifying the goodness of mental representations of spatial relationships. *Proceedings of the Human Factors Society 36th Annual Meeting, 2*, 1363-1367.



TESTING A PILOT'S REACH IN GEOMETRY COCKPIT

Testing a subject's reach in cockpits with low profiles and variable cockpit geometry. This study was done under Task 718404, "Crew Station Design and Techniques" and Workunit 71840835, "Engineering Anthropometry for Systems and Subsystems Design" by Kenneth W. Kennedy. AAMRL-TR-86-016 (1986)

Venturino, M. R., & Kunze, R. J. (1989). Spatial awareness with a helmet-mounted display. *Proceedings of the Human Factors Society 33rd Annual Meeting, 2*, 1388-1391.

Venturino, M. R., & Wells, M. J. (1990). Head movements as a function of field-of-view size on helmet-mounted display. *Proceedings of the Human Factors Society 34th Annual Meeting, 2*, 1572-1576.

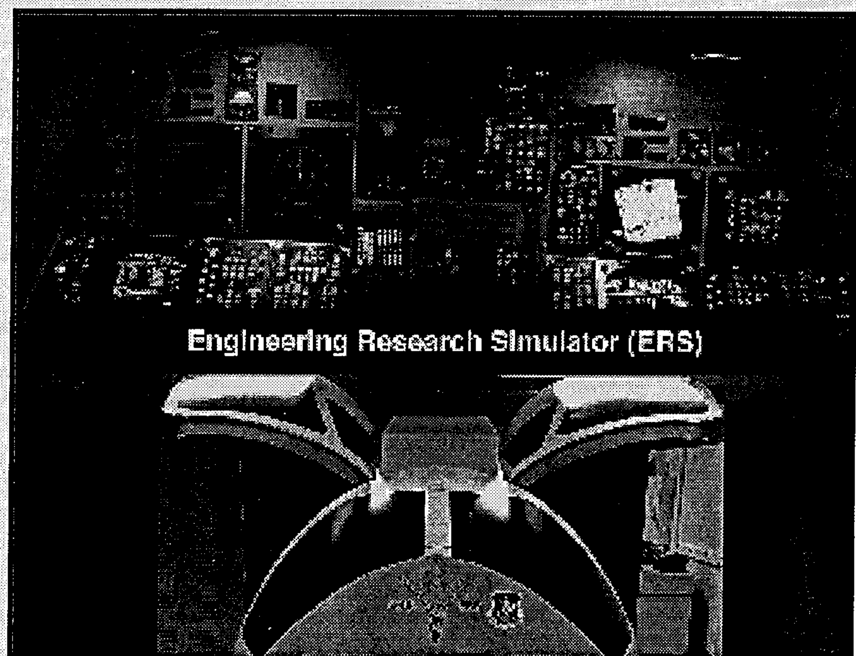
Vidulich, M., Dominguez, C., Vogel, E., & McMillan, G. (1994). *Situation awareness: Papers and annotated bibliography* (Report No. AL/CF-TR-1994-0085). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A284752)

Vidulich, M. A. (1988). The cognitive psychology of subjective mental workload. In P. A. Hancock, & N. Meshkati (Eds.), *Human mental workload* (pp. 219-229). Amsterdam: Elsevier.

Vidulich, M. A. (1988). Speech responses and dual-task performance: Better time-sharing or asymmetric transfer? *Human Factors, 30*(4), 517-529.

Vidulich, M. A. (1989). Objective measures of workload: Should a secondary task be secondary? In R. S. Jensen (Ed.), *Proceedings of the Fifth International Symposium on Aviation Psychology, 2*, 802-807.

Vidulich, M. A. (1989). Performance-based workload assessment: Allocation strategy and added task sensitivity. In S. Griffin (Ed.), *Third Annual Workshop on Space Operations, Automation, and Robotics (SOAR '89)* (NASA CP-3059, pp. 329-335). Washington, DC: National Aeronautics and Space Administration.



OPERATIONAL RELEVANCE
AL/CFHI applies multi-place and distributed crew systems design, evaluation and assessment tools to prototype crew station designs. (Task 718410)

Vidulich, M. A. (1989). The use of judgment matrices in subjective workload assessment: The Subjective Workload Dominance (SWORD) technique. *Proceedings of the Human Factors Society 33rd Annual Meeting, 2,* 1406-1410.

Vidulich, M. A. (1991). The Bedford scale: Does it measure spare capacity? *Proceedings of the Sixth International Symposium on Aviation Psychology, 2,* 1136-1141.

Vidulich, M. A. (1992). Measuring situation awareness. *Proceedings of the Human Factors Society 36th Annual Meeting, 1,* 40-41.

Vidulich, M. A., & Bortolussi, M. R. (1988). A dissociation of objective and subjective workload measures in assessing the impact of speech controls in advanced helicopters. *Proceedings of the Human Factors Society 32nd Annual Meeting, 2,* 1471-1475.

Vidulich, M. A., & Bortolussi, M. R. (1988). Speech recognition in advanced rotor-craft: Using speech controls to reduce manual control overload. *Proceedings of the American Helicopter Society National Specialists' Meeting,* 1-10.

Vidulich, M. A., Crabtree, M. S., & McCoy, A. L. (1993). Developing subjective and objective metrics of pilot situation awareness. *Proceedings of the Seventh International Symposium on Aviation Psychology, 2,* 896-900.

Vidulich, M. A., & Hughes, E. R. (1991). Testing a subjective metric of situation awareness. *Proceedings of the Human Factors Society 35th Annual Meeting, 2,* 1307-1311.

Vidulich, M. A., & Pandit, P. (1987). Individual differences and subjective workload assessment: Comparing pilots to nonpilots. *Proceedings of the Fourth International Symposium on Aviation Psychology,* 630-636.

Vidulich, M. A., & Pandit, P. (1988). Consistent mapping and spatial consistency in target detection and response execution. In J. M. Flach (Ed.), *Proceedings of the Fourth Midcentral Ergonomics/Human Factors Conference,* 39-45.

Vidulich, M. A., Stratton, M. D., Crabtree, M. S., & Wilson, G. F. (1994). Performance-based and physiological measures of situational awareness. *Aviation, Space and Environmental Medicine, 65,* A7-A12.

Vidulich, M. A., & Tsang, P. S. (1987). Absolute magnitude estimation and relative judgment approaches to subjective workload assessment. *Proceedings of the Human Factors Society 31st Annual Meeting, 2,* 1057-1061.

Vidulich, M. A., Ward, G. F., & Schueren, J. (1991). Using the Subjective Workload Dominance (SWORD) technique for projective workload assessment. *Human Factors, 33*(6), 677-691.

Vikmanis, M. M. (1987). Advances in workload measurement for cockpit design evaluation. *AGARD Conference Proceedings 425: The Man-Machine Interface in Tactical Aircraft Design and Combat Automation* (pp. 10-1 - 10-10). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-CP-425)

Warch, P., Hill, L., & Gibbons, J. (1986). *Strategic Conventional Standoff Capability (SCSC) CI system architecture* (Report No. AAMRL-TR-86-031). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. C955697)

Warr, D., Colle, H. A., & Reid, G. B. (1986). A comparative evaluation of two subjective workload measures: The Subjective Workload Assessment Technique and the modified Cooper Harper Scale. *Proceedings of Psychology in DoD Conference*, 504-508.

Warren, R. (1988). Active psychophysics: Theory and practice. *Proceedings of the 4th Annual Meeting of the International Society for Psychophysics*, 47-52.

Warren, R. (1988). Future cockpit displays. *Proceedings of the 11th Biennial Psychology in the DOD Symposium*, 91-96.

Warren, R. (1988). Visual perception in high-speed low-altitude flight. *Aviation, Space and Environmental Medicine, 59*(11,Suppl.), A116-124.

Warren, R. (1990). Preliminary questions for the study of egomotion. In R. Warren, & A. H. Wertheim (Eds.), *Perception and control of self-motion* (pp. 3-32). Hillsdale, NJ: Erlbaum.

Warren, R. (1991). Methodological problems in applied cognition & perceptual research: Theoretical implications. In R. R. Hoffman, & D. S. Palermo (Eds.), *Cognition and the symbolic processes: Applied & ecological perspectives* (pp. 507-518). Hillsdale, NJ: Erlbaum.

Warren, R. (1992). Fidelity issues in flight simulation, self-motion, and virtual reality displays. *Insight: The Visual Performance Technical Group Newsletter, 14*(September), 1,3.

Warren, R. (1993). Total visual scene information for flight. In E. Trautman (Ed.), *Vision Topics for Aviation: A new look at a traditional concern* (Report No. IST-DF-93-01, pp. 37-51). University of Central Florida, FL: Institute for Simulation and Training.

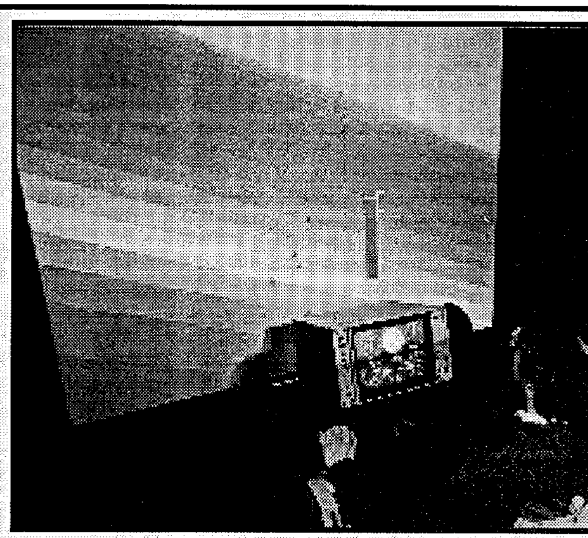
Warren, R., & Beer, J. (1992). Perception of on- and off-screen self-motion heading [Abstract]. *Proceedings of the 33rd Annual Meeting of the Psychonomics Society*, 380.

Warren, R., & Wertheim, A. H. (Eds.). (1990). *Perception and control of self-motion.* Hillsdale, NJ: Erlbaum.

Watson, H., & Coleman, A. (1986). *B-1B FLIR study model development* (Report No. AAMRL-TR-86-046). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. C954764)

Wellens, A. R. (1989). Effects of telecommunication media upon information sharing and team performance: Some theoretical and empirical observations. *IEEE Aerospace and Electronic Systems Magazine, 4*, 13-19.

Wellens, A. R. (1989). Effects of telecommunication media upon information sharing and team performance: Some theoretical and empirical observations. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 2*, 726-733.



PACLAF LOOKS AT VISUAL SAFETY CUES

High-speed, low-altitude flight over rolling terrain is difficult, especially in sparse desert environments. PACLAF, managed by Dr. Rik Warren, investigates the visual cues pilots need to safely accomplish their mission. Here the effects of texture density and a supplemental altitude display are assessed. (Task 689306)

TESTING VISION IN THE SPACE SHUTTLE

Astronauts in orbit around the Earth on Space Shuttle flight STS-36 undergoing vision tests with the Visual Function Testers VFT-1 and VFT-2. This was part of a space vision study conducted by Harry L. Task, Lt Col Mel O'Neal and Col Louis V. Genco of the Human Engineering Division. (1990) (Task 689311)

Wellens, A. R., & Ergener, D. (1988). The C.I.T.I.E.S. game: A computer-based situation assessment task for studying distributed decision making. *Simulation and Games, 19,* 304-327.

Wellens, A. R., & McNeese, M. D. (1987). A research agenda for the social psychology of intelligent machines. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 3,* 944-949.

Wells, C. H., Collins, M. T., Vanderveer, D. E., & Replogle, C. R. (1992). *Standards for chemical and biological warfare hazard modeling. Volume I, Toxicity of nerve agents and mustard in humans* (Report No. AL-TR-1992-0071). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. C050548)

Wellens, A. R. (1990). *Assessing multi-person and person-machine distributed decision making using an extended psychological distancing model* (Report No. AAMRL-TR-90-006). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A235882)

Wellens, A. R. (1991). Electronic collaboration: Some effects of telecommunication media and machine intelligence on team performance. *Fourth Annual Workshop on Space Operations, Applications, and Research (SOAR '90)* (NASA CP-3127, pp. 606-611). Washington, DC: National Aeronautics and Space Administration.

Wellens, A. R., Brown, C. E., & McNeese, M. D. (1991). Assessing electronic team technologies using computer-based dynamic decision making tasks. In Y. Queinnec, & F. Daniellou (Eds.), *Designing for everyone* (Vol. 1, pp. 667-669). New York: Taylor & Francis.

Wellens, A. R., Brown, C. E., & McNeese, M. D. (1992). Assessing electronic team technologies using computer-based dynamic decision making tasks. *Organizational Design and Management (ODAM) Bulletin, 11*(3), 9-11.

Wells, C. H., Collins, M. T., Vanderveer, D. E., & Wells, W. (1993). *Standards for chemical and biological warfare hazard modeling volume 1: Toxicity of nerve agents and mustard in humans, abridged edition* (Report No. AL-TR-1993-0026). Wright-Patterson AFB, OH: Armstrong Laboratory.

Wells, C. H., Jensen, J. G., Collins, M. T., & Replogle, C. R. (1992). *Mask protection assessment* (Report No. AL-TR-1992-0166). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. C959951)

Wells, M. J., & Haas, M. W. (1992). The human factors of helmet-mounted displays and sights. In M. A. Karim (Ed.), *Electro-optical displays* (pp. 743-785). New York: Dekker, Marcel.

Wells, M. J., & Osgood, R. K. (1991). The effects of head and sensor movement on flight profiles during simulated dive bombing. *Proceedings of the Human Factors Society 35th Annual Meeting, 1,* 22-26.

Wells, M. J., & Venturino, M. R. (1989). The effect of increasing task complexity on field-of-view requirements for a visually coupled system. *Proceedings of the Human Factors Society 33rd Annual Meeting, 1,* 91-95.

Wells, M. J., & Venturino, M. (1990). Performance and head movements using a helmet-mounted display with different sized fields-of-view. *Optical Engineering, 29*(8), 870-877.

Wells, M. J., Venturino, M., & Osgood, R. K. (1988). Using target replacement performance to measure spatial awareness in a helmet-mounted simulator. *Proceedings of the Human Factors Society 32nd Annual Meeting, 2,* 1429-1433.

Wells, M. J., Venturino, M., & Osgood, R. K. (1989). The effect of field-of-view size on performance at a simple simulated air-to-air mission. In J. T. Carollo (Ed.), *Proceedings of the Society of Photo-Optical Instrumentation Engineers (SPIE): Helmet-Mounted Displays, 1116,* 126-137.

Whiteley, J. D. (1989). *Military aircrew seating: A human factors engineering approach* (Report No. AAMRL-TR-89-046). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A218049)

Whiteley, J. D., Lusk, S. L., & Middendorf, M. S. (1990). The effects of simulator time delays on a sidestep landing maneuver: A preliminary investigation. *Proceedings of the Human Factors Society 34th Annual Meeting, 2,* 1538-1541.

Whitestone, J. J. (1993). Design and evaluation of helmet systems using 3D data. *Proceedings of the Human Factors and Ergonomics Society 37th Annual Meeting, 1,* 64-68.

Whitestone, J. J., & Robinette, K. M. (1992). High resolution human body surface data for the design of protective equipment. *Second Pan-Pacific Conference on Occupational Ergonomics,* 240-247.

Wickens, C. D., Barnett, B. J., Davis, T., & Hyman, F. (1989). Expertise, stress, and pilot judgment. *AGARD Conference Proceedings 458: Human Behavior in High Stress Situations in Aerospace Operations* (pp. 10-1 - 10-8). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-CP-458)

Wickens, C. D., Fracker, M. L., & Webb, J. M. (1987). Cross-modal interference and task integration: Resources or preemption switching? *Proceedings of the Human Factors Society 31st Annual Meeting, 1,* 679-683.

Wickens, C. D., Stokes, A., Barnett, B., & Davis, T. (1988). *Componential analysis of pilot decision making* (Report No. AAMRL-TR-88-017). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A203711)

Wickens, C. D., Stokes, A., Barnett, B., & Hyman, F. (1988). *The effects of stress on pilot judgment in a MIDIS simulator* (Report No. AAMRL-TR-88-057). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A210827)

Widdel, H., & Post, D. L. (Eds.). (1992). *Color in electronic displays.* New York: Plenum.

Wightman, F., & Kistler, D. J. (1990). *Field measurement of head related transfer functions* (Report No. AAMRL-TR-90-019). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A227850)

Wiley, L. L., & Brown, R. W. (1994). MH-53J PAVE LOW helmet-mounted display flight test. In R. J. Lewandowski, W. Stephens, & L. A. Haworth (Eds.), *Proceedings of the Society of Photo-Optical Instrumentation Engineers (SPIE): Helmet- and Head-Mounted Displays and Symbology Design Requirements, 2218,* 207-214.

Wilford, G. M., Wunsh, E., Zawodny, T. L., & Sharp, E. D. (1988). *Color coding the B-1B Threat situation format display of the AN/ALQ-161 electronic warfare system: The effect of color change, as both noise and signal, on target search performance* (Report No. AAMRL-TR-88-006). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B121929)

Wilkinson, M. O., Thibos, L. N., & Cannon, M. W. (1990). Contrast constancy: Neural compensation for image attenuation [Abstract]. *Investigative Ophthalmology and Visual Science, 31,* 323.

Wilson, D. L. (1989). Color contrast requirements for legibility of color symbology displayed against color backgrounds. *Proceedings of the Human Factors Society 33rd Annual Meeting, 2,* 1373-1377.

Wilson, D. L. (1992). *Theory of signal detection and its application to visual target acquisition: A review of the literature* (Report No. AL-TR-1992-0083). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A262920)

Wilson, D. L., & Kuperman, G. G. (1988). Strategic avionics battle-management evaluation & research/SABER. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 3*, 844-849.

Wilson, D. L., & Kuperman, G. G. (1989). *Effects of ATARS image compression on image interpretability ratings* (Report No. AAMRL-TR-89-032). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B138023)

Wilson, D. L., Kuperman, G. G., & Crawford R. L. (1992). *Effects of maximum allowed time on sustained operator performance in a counter-mobile target acquisition task* (Report No. AL-TR-1992-0070). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. C959947)

Wilson, D. L., Kuperman, G. G., & Faust, M. (1992). Psychovisual data for sensor performance modeling. *Proceedings of the Ground Target Modeling and Validation Conference*, 257-265.

Wilson, D. L., McNeese, M. D., & Brown, C. E. (1987). Team performance of a dynamic resource allocation task: Comparison of shared versus isolated work setting. *Proceedings of the Human Factors Society 31st Annual Meeting, 2*, 1345-1349.

Wilson, D. L., McNeese, M. D., Brown, C. E., & Wellens, A. R. (1987). *Utility of shared versus isolated work setting for dynamic team decision making* (Report No. AAMRL-TR-87-072). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A192434)

Wilson, G. F. (1988). Probe evoked magnetic & electrical responses during a spatial rotation task. *Psychophysiology, 25*(4,Suppl.), 490.

Wilson, G. F. (1989). PATS: A new generation psychophysiological test battery. *Proceedings of the Human Factors Society 33rd Annual Meeting, 2*, 1173-1176.

Wilson, G. F. (1991). The use of heart rate and heart rate variability to measure workload in F4 pilots and WSO's during training flights and a tracking task. *Aviation, Space and Environmental Medicine, 61*, 450.

Wilson, G. F. (1992). Applied use of cardiac and respiration measures: Practical considerations and precautions. *Biological Psychology, 34*(2-3), 163-178.

Wilson, G. F. (Ed.). (1992). Cardiorespiratory measures and their role in studies of performance [Special issue]. *Biological Psychology, 34*(2-3).

Wilson, G. F. (1992). *Progress in the psychophysiological assessment of workload* (Report No. AL-TR-1992-0007). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A263609)

Wilson, G. F. (1993). Air-to-ground training missions: A psychophysiological workload analysis. *Ergonomics, 36*(9), 1071-1088.

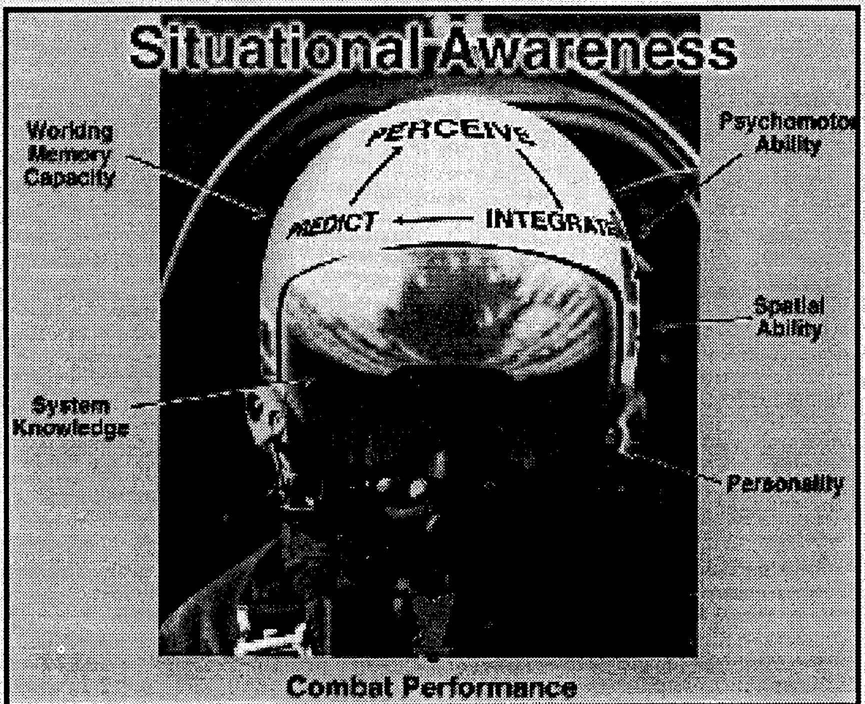
Wilson, G. F. (1993). Cardiorespiratory measures and their role in studies of performance. *CSERIAC Gateway, 4*(2), 18.

Wilson, G. F. (1994). Workload Assessment Monitor (WAM). *Proceedings of the Human Factors and Ergonomics Society 38th Annual Meeting, 2*, 944.

Wilson, G. F., & Badeau, A. (1992). Psychophysiological measures of cognitive workload in laboratory and flight. *Sixth Annual Workshop on Space Operations, Applications, and Research (SOAR '92)* (pp. 169-175). Washington, DC: National Aeronautics and Space Administration.

Wilson, G. F., Busch, C., Papanicolaou, A., Oliver, C. G., & Orr, C. (1989). Cortical resource allocation during mental rotation determined by magneto and electro encephalography. In S. J. Williamson, M. Hoke, G. Stroink, & M. Kotani (Eds.), *Advances in biomagnetism: Proceedings of the 7th International Conference on Biomagnetism* (Vol. 2, pp. 233-236). New York: Plenum.

Wilson, G. F., & DeRego, P. (1987). Hemispheric asymmetries in phonetic processing assessed with probe evoked magnetic fields. In



PILOT SITUATIONAL AWARENESS CRITICAL TO COMBAT SUCCESS

Pilot Situational Awareness involves the continuous perception and integration of information and the prediction of future events. Many factors contribute to good situational awareness, including personality, cognitive abilities, and training. (Task 718414)

K. Atsumi, M. Kotani, S. Ueno, T. Katila, & S. J. Williamson (Eds.), *Advances in biomagnetism: Biomagnetism 87* (pp. 210-216). Tokyo: Tokyo & Denki University Press.

Wilson, G. F., & Eggemeier, F. T. (1991). Psychophysiological assessment of workload in multi-task environments. In D. L. Damos (Ed.), *Multiple task performance* (pp. 329-360). London: Taylor & Francis.

Wilson, G. F., & Eggemeier, F. T. (1994). Mental workload assessment. *CSERIAC Gateway, 5(2),* 1-4.

Wilson, G. F., & Fisher, F. (1990). Classification of flight segment using pilot & WSO physiological data. *Proceedings of the Human Factors Society 34th Annual Meeting, 1,* 109-111.

Wilson, G. F., & Fisher, F. (1990). The use of multiple physiological measures to determine flight segment in F4 pilots. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 2,* 859-861.

Wilson, G. F., & Fisher, F. (1991). Cognitive task classification using EEG spectra [Poster]. *Psychophysiology, 28*(3A,Suppl.), S62.

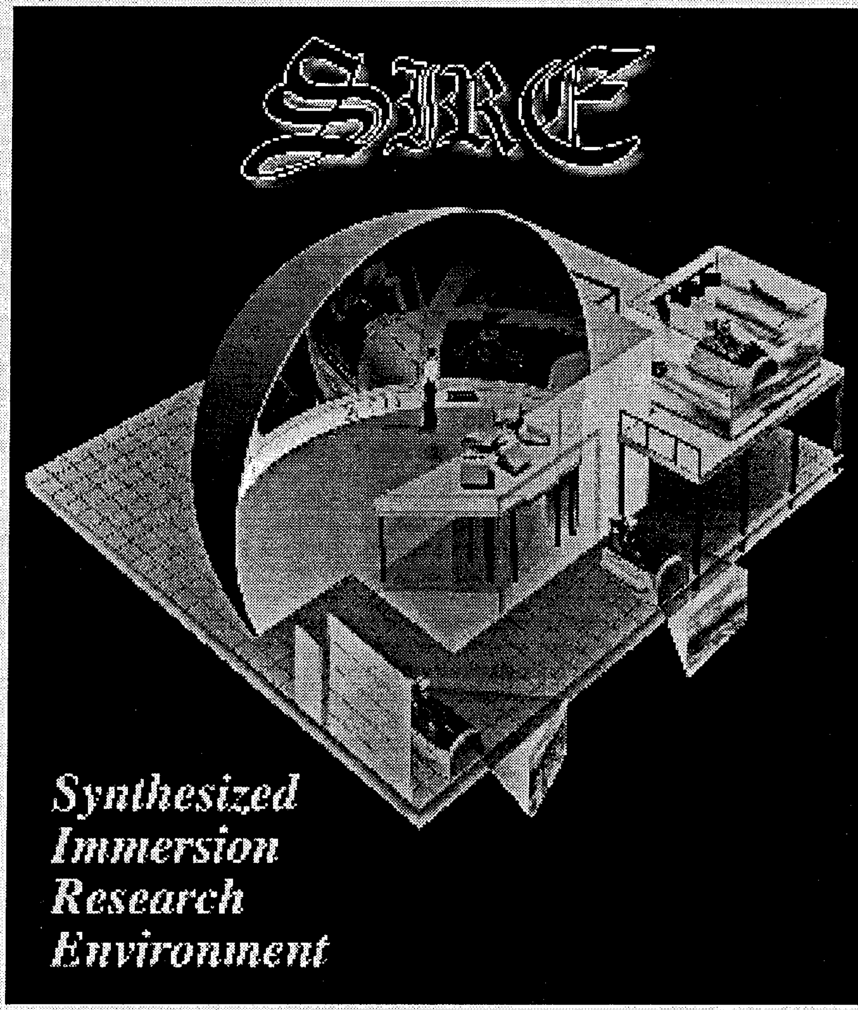
Wilson, G. F., & Fisher, F. (1991). The use of cardiac and eye blink measures to determine flight segment in F4 crew. *Aviation, Space and Environmental Medicine, 62,* 959-961.

Wilson, G. F., & Fullenkamp, P. A. (1989). A comparison of pilot and WSO workload during training missions using psychophysiological data. In E. Farmer (Ed.), *Stress and error in aviation: Proceedings of the XVIII Western European Association for Aviation Psychology Conference* (Vol. 2, pp. 27-34). Worcester, Great Britain: Billing & Sons.

Wilson, G. F., Fullenkamp, P. A., & Davis, I. E. (1990). Physiological measures of pilot and WSO workload during air-to-ground missions. *Aviation, Space and Environmental Medicine, 61,* 454.

Wilson, G. F., Fullenkamp, P., & Davis, I. E. (1994). Evoked potential, cardiac, blink & respiration measures of pilot workload in air-to-ground missions. *Aviation, Space and Environmental Medicine, 65,* 100-105.

Wilson, G. F., Fullenkamp, P. A., Sullivan, C., Gundel, A., & Davis, I. E. (1989). Evoked brain potentials recorded during airborne and ground tasks. *Aviation, Space and Environmental Medicine, 60,* 495.



SYNTHESIZED IMMERSION RESEARCH ENVIRONMENT (SIRE)
The Synthesized Immersion Research Environment (SIRE) became operational in 1994 and supported the integration and assessment of multi-sensory, virtually augmented human-system interface concepts. SIRE included several autonomous research stations, the largest of which was a 40-foot diameter spherical projection surface linked to a general-purpose Silicon Graphics Onyx graphics generator supporting scientific visualization and multi-sensory research. (Task 718419)

Wilson, G. F., & Hankins, T. (1994). EEG and subjective measures of private pilot workload. *Proceedings of the Human Factors and Ergonomics Society 38th Annual Meeting, 2,* 1322-1325.

Wilson, G. F., Hughes, E., & Hassoun, J. A. (1990). Physiological & subjective evaluation of a new aircraft display. *Proceedings of the Human Factors Society 34th Annual Meeting, 2,* 1441-1443.

Wilson, G. F., Luciani, R. J., & Ratino, D. A. (1987). Motion evoked vestibular potential. *AGARD Conference Proceedings 432: Electrical and Magnetic Activity on the Central Nervous System: Research and Clinical Applications in Aerospace Medicine* (pp. 32-1 - 32-8). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-CP-432)

Wilson, G. F., & McCloskey, K. A. (1988). Using probe evoked potentials to determine information processing demands. *Proceedings of the Human Factors Society 32nd Annual Meeting, 2,* 1400-1403.

Wilson, G. F., & McCloskey, K. A. (1989). Task and adaptation effects upon cardiac and respiration measures. *Psychophysiology, 26*(4A,Suppl.), S66.

Wilson, G. F., McCloskey, K., & Davis, I. (1987). Evoked response, performance and subjective measures in a linguistic processing task. *Proceedings of the Fourth International Symposium on Aviation Psychology,* 623-629.

Wilson, G. F., & Mulford, L. L. (1994). Register of psychophysiologists. In J. A. Caldwell, G. F. Wilson, M. Cetinguc, A. W. K. Gaillard, A. Gundel, D. Lagarde, S. Makeig, G. Myhre, & N. A. Wright (Eds.), *Psychophysiological Assessment Methods* (AGARD-AR-324, pp. J-1 - J-42). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development.

Wilson, G. F., & O'Donnell, R. D. (1987). Cortical evoked response and eyeblink measures in the workload evaluation of alternative landing system displays. In A. Roscoe (Ed.), *AGARDograph 282: Aerospace Medical Panel Working Group 16: The practical assessment of pilot workload* (pp. 8-52 - 8-55). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-AG-282)

Wilson, G. F., & O'Donnell, R. D. (1988). Measurement of operator workload with the neuropsychological workload test battery. In P. A. Hancock, & N. Meshkati (Eds.), *Advances in psychology: Vol. 52. Human mental workload* (pp. 63-100). New York: North Holland.

Wilson, G. F., & Oliver, C. G. (1989). PATS: Psychophysiological assessment test system. In E. Farmer (Ed.), *Stress and error in aviation: Proceedings of the XVIII Western European Association for Aviation Psychology Conference* (Vol. 2, pp. 15-26). Worcester, Great Britain: Billing & Sons.

Wilson, G. F., & Oliver, C. G. (1992). PATS: Psychophysiological assessment test system, goals and description. *Aviation, Space and Environmental Medicine, 63*, 403.

Wilson, G. F., Palmer, B., & Badeau, A. F. (1993). *Workload Assessment Monitor (WAM) users' manual.* Wright-Patterson AFB, OH: Armstrong Laboratory.

Wilson, G. F., Palmer, B., Oliver, C. G., & Swain, R. (1991). Topographical analysis of cognitive task difficulty. *Proceedings of the Second International Congress on Brain Electromagnetic Topography*, 326.

Wilson, G. F., Palmer, B., Reis, G., & Gravelle, M. (1994). Changes in cardiac and eyeblink measures while performing the AGARD stress battery after one night sleep loss. *Aviation, Space and Environmental Medicine, 65*, 457.

Wilson, G. F., Purvis, B. D., & Skelly, J. J. (1987). Physiological data used to measure pilot workload in actual flight & simulator conditions. *Proceedings of the Human Factors Society 31st Annual Meeting, 2*, 779-783.

Wilson, G. F., Ratino, D. A., Floyd, L. L., Luciani, R. J., & Rodriguez, L. E. (1989). *Brain stem evoked responses in altered environments* (Report No. AAMRL-TR-89-016). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A220097)

Wilson, G. F., Skelly, J. J., & Purvis, B. D. (1988). Reactions to emergency situations in actual and simulated flight. *AGARD Conference Proceedings 458: Human Behavior in High Stress Situations in Aerospace Operations* (pp. 9-1 - 9-13). Neuilly sur Seine, France: NATO Advisory Group for Aerospace Research and Development. (NTIS No. AGARD-CP-458)

Wilson, G. F., Swain, R., & Davis, I. E. (1988). Human event related potentials during spatial processing: A topographical distribution. *Society for Neuroscience: Abstracts, 14*(2), 1014.

Wilson, G. F., Swain, R. A., & Davis, I. E. (1994). Topographical analysis of cortical evoked activity during a variable demand spatial processing task. *Aviation, Space and Environmental Medicine, 65*, A54-A61.

Wilson, G. F., Ullsperger, P., & Busch, C. (1993). Influence of difficulty level on ERP components elicited in response to warning stimuli. *Psychophysiology, 30*(Suppl. 1), S71.

Wittenberg, A. M. (1986). *Single crystal phosphor development* (Report No. AAMRL-TR-86-041). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. B109276)

Wittman, W. T., & Healy, A. F. (1994). A long-term retention advantage for spatial information learned naturally and in the laboratory. In A. F. Healy, & L. E. Bourne (Eds.), *Learning and Memory of Knowledge and Skills: Durability and Specificity* (pp. 170-205). Thousand Oaks, CA: SAGE Publications.

Wohl, J. G., & Tenney, R. R. (1987). *Integrated analysis techniques for command, control, and communications systems; Vol. I: Methodology* (Report No. AAMRL-TR-87-040). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A197126)

"The research emphasis at the lab has shifted over the years. When I first got there, we were still really focused in on 'knobs and dials' — the classical applied human engineering concerns. But, after struggling with constructs like 'workload,' I believe the emphasis moved in the direction of cognitive psychology. From my admittedly biased perspective, I see human factors moving more in the direction of the cognitive and neuropsychological sciences. People who get into human factors research now are educated much more in the cognitive areas than previously. They are attacking more complicated problems like situation awareness, workload, and so forth. I think that's where the breakthroughs will come."

— Robert O'Donnell, Chief
Workload and Ergonomics Branch
Human Engineering Division

Wohl, J. G., & Tenney, R. R. (1987). *Integrated analysis techniques for command, control, and communications systems; Vol. II: Applications* (Report No. AAMRL-TR-87-040). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A197126)

Wolpert, L., Reardon, K. A., & Warren, R. (1989). The effect of changes in edge and flow rates on altitude control. In R. S. Jensen (Ed.), *Proceedings of the Fifth International Symposium on Aviation Psychology, 2,* 749-754.

Yolton, R. L., Wilson, G. F., Davis, I., & McCloskey, K. A. (1987). Physiological correlates of behavioral performance on the mathematical processing subtest of the CTS battery. *Proceedings of the Human Factors Society 31st Annual Meeting, 2,* 770-773.

Young, M. F., & McNeese, M. D. (in press). A situated cognition approach to problem solving. In J. M. Flach, P. A. Hancock, J. Caird, & K. Vicente (Eds.), *The ecology of human-machine systems* (Vol. 2). Hillsdale, NJ: Erlbaum.

Young, M. F., & McNeese, M. D. (1993). A situated cognition approach to problem solving with implications for computer-based learning and assessment. In G. Salvendy, & M. J. Smith (Eds.), *Human-computer interaction: Software and hardware interfaces* (Vol. 2, pp. 825-830). Amsterdam: Elsevier.

Zacharias, G. L., Miao, A. X., Riley, E. W., & Osgood, R. K. (1993). *Situation awareness metric for cockpit configuration evaluation* (Report No. AL-TR-1993-0042). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC B176582)

Zacharias, G. L., Miao, A. X., & Warren, R. (in press). Multistage integration model for human egomotion perception. *AIAA Journal of Guidance, Control & Dynamics.*

Zacharias, G. L., Miao, A. X., & Warren R. (1993). Multistage integration model for human egomotion perception. *AIAA Flight Simulation Technologies Conference,* 103-113.

Zacharias, G. L., Venturino, M., & Osgood, R. K. (1992). *Situation awareness metric for cockpit configuration evaluation* (Report No. AL-SR-1992-0020). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B179427)

"The seat in the F-16 had been reclined to 30 degrees due to the raised heel rest line which was designed to accommodate for the air intake under the plane's belly. But the F-16 Program Office advocated that the increased recline angle of the seat would also improve G tolerance. Pilots reported increased ability to tolerate high Gs with this seat; however, we found this anecdotal evidence was refuted by subsequent centrifuge data, and it was thought that the pilot's perceptions of increased G tolerance were just a reflection of the improved comfort of the reclined seat. That is, they were more comfortable, but G tolerance was no better. We used centrifuge studies to test the effectiveness of different angles of seat recline, and a new database emerged providing valuable data on high G tolerance which still serves as a reference today."

— Phil Kulwicki, Technical Director
Crew-Centered Cockpit Design
Human Engineering Division

Zaff, B. S., Hughes, E. R., McNeese, M. D., Brown, C. E., & Citera, M. (1993). Diagnosing macro-ergonomic problems: A case study in the use of concept mapping for TQM initiatives. *Proceedings of the Human Factors and Ergonomics Society 37th Annual Meeting, 2,* 873-877.

Zaff, B. S., & McNeese, M. D. (1991). Design acquisition: Translating user knowledge into design solutions. *Proceedings of Interface '91,* 42-49.

Zaff, B. S., & McNeese, M. D. (1991). An integrated methodology for knowledge and design acquisition. *Proceedings of the IEEE National Aerospace and Electronics Conference (NAECON), 2,* 779-785.

Zaff, B. S., McNeese, M. D., Brown, C. E., Citera, M., & Selvaraj, J. A. (1993). Empowering designers with user-centered knowledge: Issues, methods, and solutions. *Proceedings of Interface '93,* 231-235.

Zaff, B. S., McNeese, M. D., & Snyder, D. E. (1993). Capturing multiple perspectives: A user-centered approach to knowledge acquisition. *Knowledge Acquisition, 5*(1), 79-116.

Zaff, B. S., McNeese, M. D., Snyder, D. E., & Lizza, C. S. (1991). An integrated knowledge representation: Developing a large scale knowledge base for the pilot's associate. *Proceedings of the Associate Technology Symposium,* 244-255.

Zehner, G. F. (1986). Three-dimensional summarization of face shape. *Proceedings of the Human Factors Society 30th Annual Meeting, 1*, 206-210.

Zehner, G. F. (1994). Anthropometric accommodation in USAF cockpits. In K. Krishen (Ed.), *Seventh Annual Workshop on Space Operations, Applications and Research (SOAR '93)* (NASA CP-3240). Washington, DC: National Aeronautics and Space Administration.

Zehner, G. F., Deason, V. B., Ervin, C. A., & Daziens, P. (1987). *A photographic device for the collection of anthropometric data on the hand* (Report No. NATICK-TR-87-044). Natick, MA: U.S. ARMY Natick Research Development and Engineering Center.

Zehner, G. F., Ervin, C. A., Robinette, K. M., & Daziens, P. (1987). *Fit evaluation of female body armor* (Report No. AAMRL-TR-87-046). Wright-Patterson AFB, OH: Armstrong Aerospace Medical Research Laboratory. (DTIC No. A188721)

Zehner, G. F., Meindl, R. S., & Hudson, J. A. (1992). *A multivariate anthropometric method for crew station design: Abridged* (Report No. AL-TR-1992-0164). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. A274588)

Zimmerman, G., & Lintz, A. (1994). *Magneto-optic gravity induced loss of consciousness monitor* (Report No. AL/CF-SR-1994-0007). Wright-Patterson AFB, OH: Armstrong Laboratory. (DTIC No. B188064)